GENERAL, TECHNICAL DATA

TECHNICAL DATA

Engine Code and Serial number, locations

The Engine Code number ("Code letters" plus "Serial number") can be found between the Diesel injection pump and the exhaust manifold on the engine block.

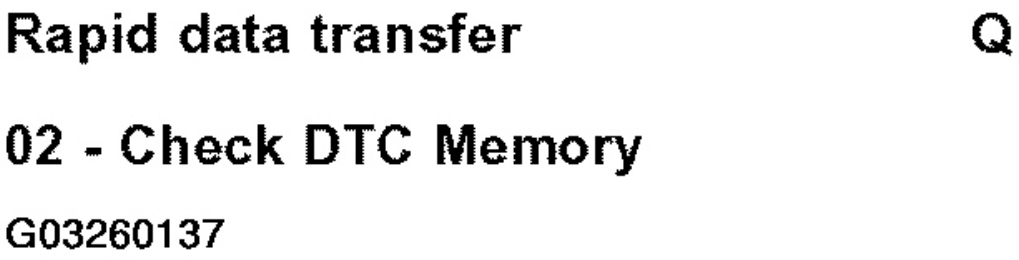


Fig. 1: Identifying Engine Code Number
Courtesy of VOLKSWAGEN OF AMERICA, INC.

There is also a sticker on the toothed belt guard showing the "Engine code" and "Serial number".

The Engine Code is also included on the vehicle data plate.

Engine data

ENGINE DATA

Engine Code letters	**ALH**
Production	from 10.97
Displacement liters	1.9
Power kW at 1/min	66/3750
Torque N.m at 1/min	210/1900
Bore diameter mm	79.5
Stroke mm	95.5
Compression	19.5

CZ (Cetane rating) minimum	45
Ignition sequence	1 - 3 - 4 - 2
Catalytic converter	YES
Exhaust Gas Recirculation	YES (1)
Turbocharging	YES
Charge Air cooling	YES
(1) With EGR cooling	

ENGINE - ASSEMBLY

ENGINE, REMOVING AND INSTALLING

Special tools and equipment

- 2024 A Engine sling
- T10012 Engine/trans. support
- VW 313 Holding fixture
- VW 540 Holding fixture / transmission support
- VAG 1202 A Workshop crane
- VAG 1306 Drip tray for VAG 1202A

Fig. 2: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG 1331 Torque wrench: 5 to 50 Nm (3.7 to 37 ft lb)
- VAG 1332 Torque wrench 40 to 200 Nm (30 to 148 ft lb)
- VAG 1383A Engine/transmission jack
- VAG 1921 Hose clip pliers
- VAS 5085 Step ladder
- G 000 100 grease (manual transmission only)
- M10 x 25 / 8.8 Bolt

- Cable tie

Fig. 3: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

CAUTION: Obtain the radio anti-theft code from the customer BEFORE disconnecting the battery Ground strap.

NOTE:

- **After making sure that the ignition is switched OFF, disconnect the battery Ground strap.**
- **All cable ties which were opened or cut open to remove the engine/transmission assembly, must be replaced in the original position when installing the engine.**
- **Remove the engine/transmission assembly downward.**
- **Remove the engine cover.**
- **Remove power steering reservoir from battery support, thereby not having to loosen the fluid hoses.**
- **Attach coolant reservoir to upper radiator support.**
- **Remove the battery and battery hold-down.**
- **Remove Air Cleaner.**
- **Remove connecting pipe between the Charge Air cooler and intake manifold complete with EGR Vacuum Regulator solenoid valve -N18-.**

- Disconnect fuel supply and return lines at fuel filter.

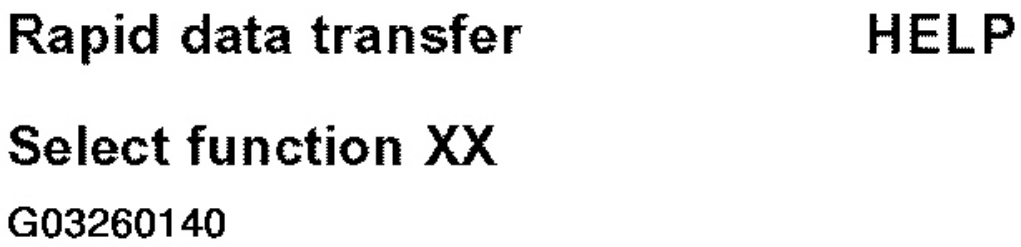


Fig. 4: Disconnecting Fuel Supply And Return Lines
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Seal off lines so fuel system is not contaminated by dirt etc.

Vehicles with manual transmission

- Disconnect selector mechanism from transmission.

See **SELECTOR MECHANISM ON TRANSMISSION SIDE, UP TO 5.99 DISASSEMBLING AND ASSEMBLING** or **SELECTOR MECHANISM ON TRANSMISSION SIDE, AS OF 6.99 DISASSEMBLING AND ASSEMBLING** .

- Remove hydraulic clutch slave cylinder:

See **CLUTCH SLAVE CYLINDER**

Vehicles with automatic transmission

- Remove Transmission Range selector lever cable from transmission:

See **SELECTOR LEVER CABLE**

All vehicles

- Remove sound dampening tray:

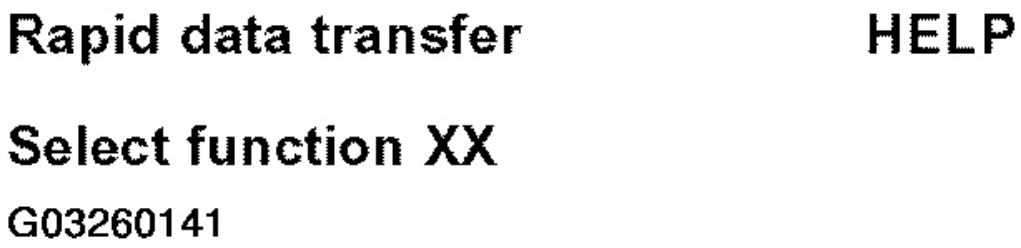


Fig. 5: Removing Sound Dampening Tray
Courtesy of VOLKSWAGEN OF AMERICA, INC.

See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Drain engine coolant. See **COOLING SYSTEM, DRAINING AND FILLING**
- Remove line between charge air cooler and turbocharger.
- Pull radiator hoses off engine using VAG 1921 hose clip pliers.
- Remove lower coolant hose from radiator.
- Remove auxiliary filter, if available, on right side of vehicle.
- Loosely unscrew pendulum support (arrows).

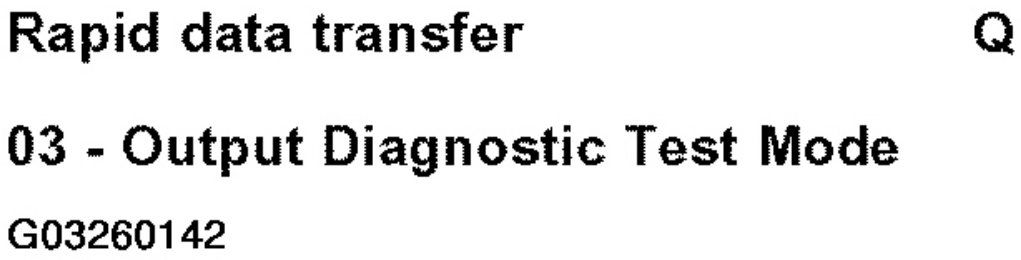


Fig. 6: Removing Pendulum Support Screw
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pull vacuum and breather hoses off engine.
- Disconnect all wiring from the transmission, Generator and starter and move them to one side for clearance.

- Remove front exhaust pipe. See **FRONT EXHAUST PIPE AND CATALYST WITH ATTACHMENTS**
- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove power steering pump with bracket and lay to one side.
- Hoses remain connected:

See **POWER STEERING PUMP, RESERVOIR, HYDRAULIC LINES** .

- Remove right hand inner Constant Velocity joint protective cover from engine if installed.
- Remove right-hand drive shaft and disconnect left-hand drive shaft at transmission:

See **FRONT AXLE SHAFT** .

- Unscrew mounting bolts for power steering pressure line.

Vehicles with A/C:

- Observe additional information and removal instructions. See **VEHICLES WITH A/C, ADDITIONAL INFORMATION AND REMOVAL INSTRUCTIONS** .
- Remove starter.

See appropriate STARTERS article.

All vehicles:

- Insert engine bracket 3396 into VAG 1383 A engine / transmission jack.
- Remove coolant hose bracket and lower from cylinder block.
- Thread hole is used to fasten T 10012 engine bracket
- Thread on T 10012 engine bracket using M10x 25 5/ 8.8 nut and bolt.

Output Diagnostic Test Mode

Loudspeaker

G03260143

Fig. 7: Threading On T 10012 Engine Bracket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Attach to engine block with 25 Nm (18 ft lb)

- Slightly lift engine/transmission assembly using VAG 1383 A jack.
- Loosely unscrew engine mount (engine side) from top of engine bracket (arrows).

Fig. 8: Removing Engine Mount Screw
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Use VAS 5085 tool to remove the mounting bolts.

- Loosely unscrew engine mount/transmission mount from transmission bracket (arrows) from top.

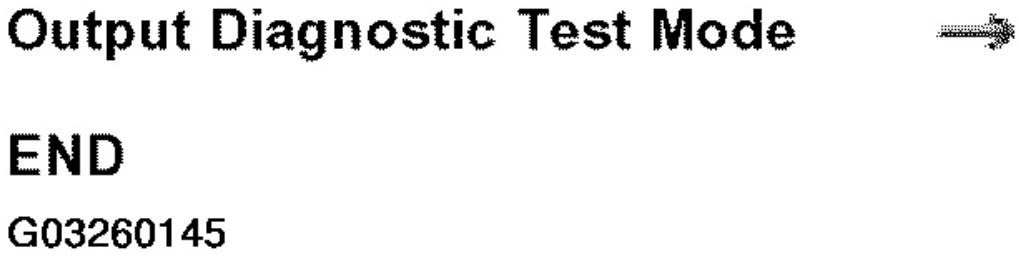


Fig. 9: Removing Engine Mount/Transmission Mount Screw
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully lower engine/transmission assembly.

- While lowering, carefully guide the power steering fluid line past the transmission.

NOTE: Carefully guide the engine and transmission assembly during the lowering process to prevent bodywork damage.

Engine assembly stand, attaching engine

NOTE: To work on the engine outside of the vehicle, attach engine to assembly stand using the VW 313 holding fixture along with the VW 540 engine/transmission support.

Work sequence

- Transfer Engine/transmission subassembly to workbench via VAG 1383 A engine/transmission jack.

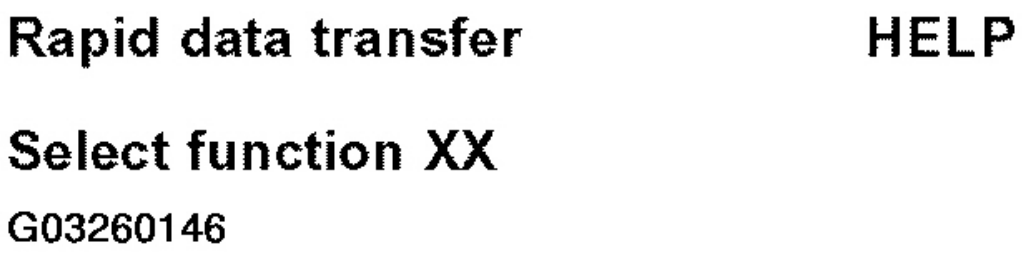


Fig. 10: Identifying Transfer Engine/Transmission Subassembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lower the engine/transmission assembly such that the transmission is supported.
- Remove lower engine/transmission connecting bolt.
- Push transmission off engine, while pushing the torque converter out of the drive plate.

Vehicles with automatic transmission

- Remove nut from torque converter.
- Clamp off ATF cooler hoses and disconnect at transmission cooler.
- Seal off transmission cooler using clean plugs.
- Secure torque converter to prevent it from falling out.

All vehicles

- Attach 2024A engine sling using 2024 A/1 extension as follows and lift from VAG 1383 engine/transmission jack using workshop crane:
  - Pulley end: 4th hole in hook at position 1
  - Flywheel end: 4th hole in hook at position 8

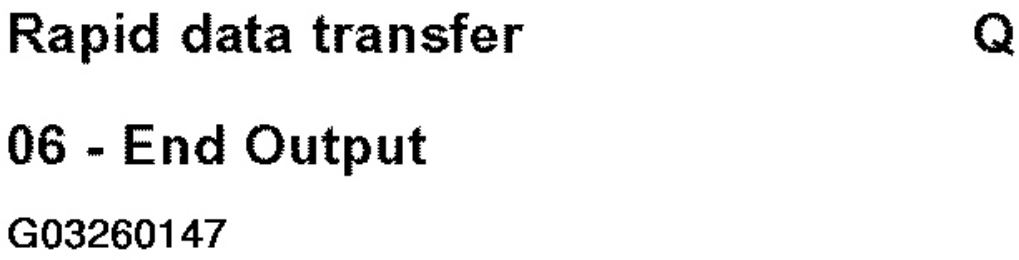


Fig. 11: Attaching 2024A Engine Sling
Courtesy of VOLKSWAGEN OF AMERICA, INC.

WARNING: Secure ALL hooks and locating pins with lock pins!

NOTE:

- **Positions marked 1 to 4 on the bar must be located toward the pulley end of the engine.**
- **The holes in the hooks are counted up from the hook.**

- Secure engine to holding fixture VW 313 using VW 540 engine/transmission support and VW 540/1 supplementary kit.

Installation notes

Installation is reverse of removal, note the following during installation:

- Check whether centering dowels for engine/transmission are installed in the cylinder block, install if necessary.
- Install intermediate plate onto sealing flange and slide onto dowel sleeves (arrows).

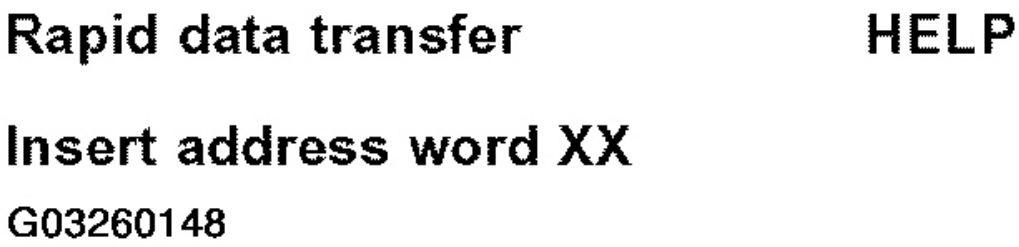


Fig. 12: Installing Intermediate Plate Onto Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with manual transmission

- Check clutch release bearing for wear, replace if necessary.
- Lightly grease clutch release bearing, release bearing guide sleeve and splines on input shaft using G 000 100.
- Install hydraulic clutch slave cylinder:

See **CLUTCH SLAVE CYLINDER**

- Install selector mechanism:

See **SELECTOR MECHANISM** .

- If necessary adjust gear change cables:

See **SELECTOR MECHANISM** .

Vehicles with automatic transmission

- Replace the lock washer on the selector cable anchorage.
- Install selector cable on transmission, adjust if necessary:

See **SELECTOR LEVER CABLE** .

All vehicles

- When installing the engine and transmission assembly, make sure sufficient clearance to drive shafts.
- While raising, carefully guide the power steering fluid line past the transmission.
- Engine and Transmission subassembly is aligned transversely so there is a distance between engine

mount -1- and engine bracket -2- of approx. 10 mm (installed condition).

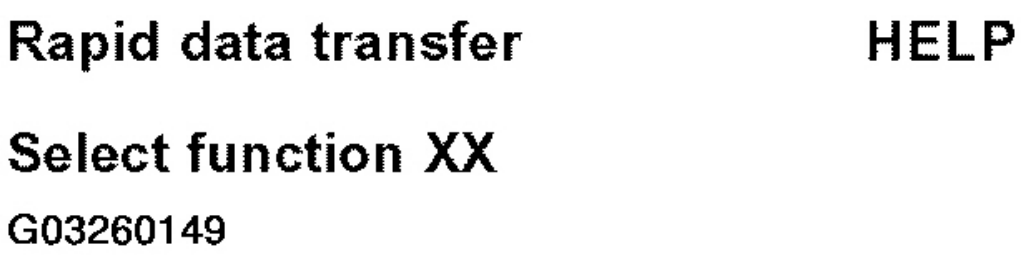


Fig. 13: Aligning Engine Mount And Engine Bracket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- When bolting the mount support arm to the engine support and transmission console, the engine and transmission mount must not be stressed (aligned parallel to each other).

Tightening torques. See **TIGHTENING TORQUES** .

- Remove left-hand drive shaft and disconnect right-hand drive shaft at transmission:

See **FRONT AXLE SHAFT** .

- Remove front exhaust pipe. See **FRONT EXHAUST PIPE AND CATALYST WITH ATTACHMENTS.**
- Remove connecting pipe between charge air cooler and intake manifold with EGR Vacuum Regulator solenoid valve.
- Install power steering pump:

See **POWER STEERING PUMP: VEHICLES WITH POWER STEERING IN LOWER SECTION, REMOVING AND INSTALLING** or **POWER STEERING PUMP: VEHICLES WITH POWER STEERING IN UPPER SECTION, REMOVING AND INSTALLING** .

- Electrical connections and routing:

See appropriate WIRING DIAGRAM article

- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Install sound dampening tray:

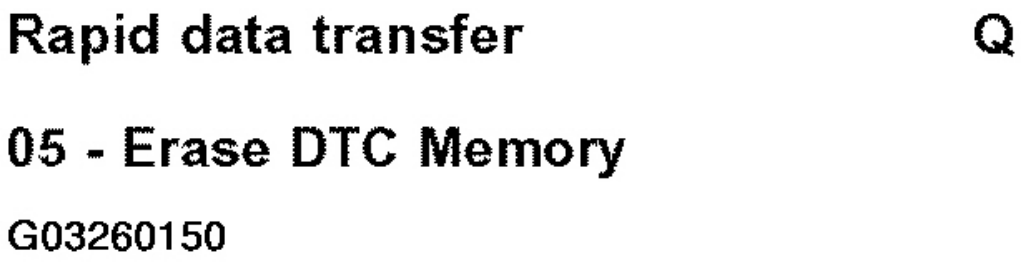


Fig. 14: Installing Sound Dampening Tray
Courtesy of VOLKSWAGEN OF AMERICA, INC.

See **NOISE INSULATION, ASSEMBLY OVERVIEW** .

- Fill with engine coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .

Tightening torques

TIGHTENING TORQUE CHART - ENGINE REMOVAL & INSTALLATION

Bolted joint	Metric Size	Tightening torque
Bolts, nuts	M 6	10 Nm 7 ft lb
	M 8	25 Nm 18 ft lb
	M10	40 Nm 30 ft lb
	M 12	60 Nm 44 ft lb
Variations on the above:		
Engine to transmission M12 connecting bolts		80 Nm 59 ft lb
Torque converter to drive plate		60 Nm 44 ft lb
Drive shaft to flange / transmission		40 Nm 30 ft lb
Front exhaust pipe to turbocharger		25 Nm 18 ft lb

Engine and transmission assembly, mountings

Tightening torques

NOTE: **The FRONT ENGINE/TRANSMISSION MOUNT TIGHTENING TORQUE CHART table refers to items in Fig. 15 .**

FRONT ENGINE/TRANSMISSION MOUNT TIGHTENING TORQUE CHART

Application	Specfication
1 - Mount to body (1)	40 Nm (30 ft lb) + 90° (1/4 turn.)
2 - Mount/bracket to body	25 Nm (18 ft lb)
3 - Mount to engine bracket (1)	60 Nm (44 ft lb) + 90° (1/4 turn.)
(1) Replace bolts	

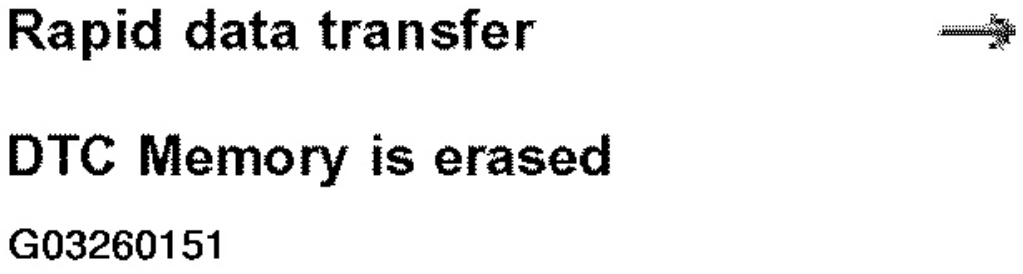


Fig. 15: Identifying Front Engine/Transmission Mount
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: **The RIGHT REAR ENGINE/TRANSMISSION MOUNT TIGHTENING TORQUE CHART table refers to items in Fig. 16 .**

RIGHT REAR ENGINE/TRANSMISSION MOUNT TIGHTENING TORQUE CHART

Application	Specification
1 - Mount to body (1)	40 Nm (30 ft lb) + 90° (1/4 turn.)
2 - Mount to body	25 Nm (18 ft lb)
3 - Mount to transmisison console (1)	60 Nm (44 ft lb) + 90° (1/4 turn.)
(1) Replace bolts	

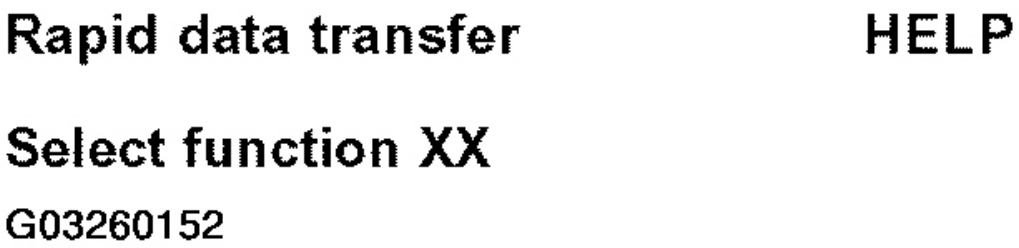


Fig. 16: Identifying Right Rear Engine/Transmission Mount
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The PENDULUM SUPPORT TIGHTENING TORQUE CHART table refers to items in Fig. 17 .

PENDULUM SUPPORT TIGHTENING TORQUE CHART

Application	Specification
1 - Pendulum support to transmission (1)	40 Nm (30 ft lb) + 90° (1/4 turn.)
2 - Pendulum support to transmission (1)	40 Nm (30 ft lb)+ 90° (1/4 turn.)
3 - Pendulum support to engine (1)	20 Nm (15 ft lb) + 90° (1/4 turn.)
(1) Replace bolts	

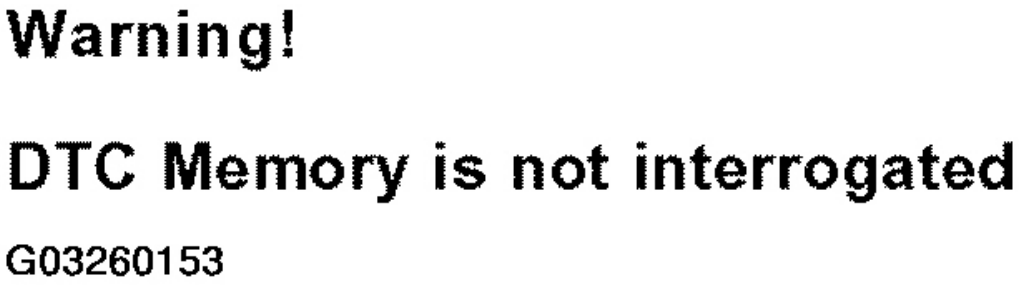


Fig. 17: Identifying Pendulum Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with A/C, additional information and removal instructions

WARNING: Do NOT open the A/C refrigerant circuit.

NOTE: To prevent damage to the condenser and to the refrigerant lines/hoses, make sure that the lines and hoses are not stretched, kinked or bent.

To ease engine removal and installation without opening the A/C refrigerant circuit:

- Remove retaining clamp(s) from refrigerant lines.
- Remove A/C compressor:

See **A/C REFRIGERANT SYSTEM, SERVICING** , item 13.

- Attach A/C compressor to vehicle body to provide stress relief for refrigerant lines/hoses.

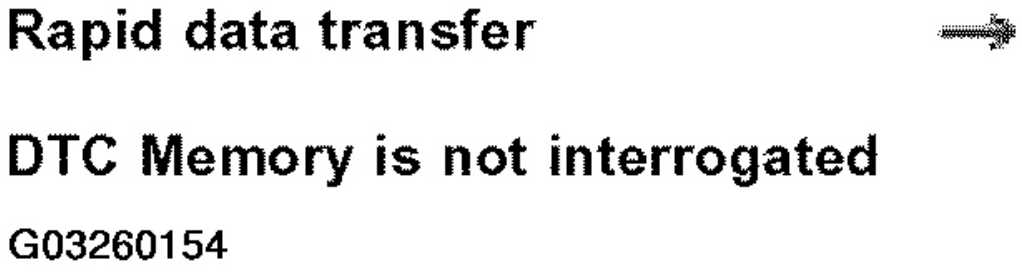


Fig. 18: Attaching A/C Compressor To Vehicle Body
Courtesy of VOLKSWAGEN OF AMERICA, INC.

ENGINE - CRANKSHAFT, CYLINDER BLOCK

ENGINE, DISASSEMBLING AND ASSEMBLING

NOTE:

- **If during repairs, metal shavings or quantities of small metal particles are found in the engine oil - caused, for example, by partial seizure of the crankshaft and conrod bearings - then, besides thoroughly cleaning out the oil passages, also replace the oil cooler.**
- **Faulty injectors can cause violent knocking noises in the engine which sound like faulty bearings. When this occurs, run engine at idle and slacken off the injector line unions one after the other. If the knocking stops when a specific union is loosened, this is an indication that the**

respective injector is faulty.

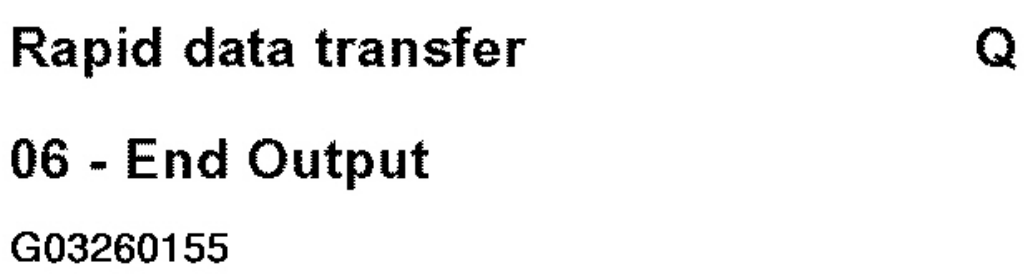


Fig. 19: Locating External Engine Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Fuel injectors, servicing

See **FUEL INJECTORS, SERVICING** .

I. See **PART I**
II. See **PART II**

Part I

NOTE: The following list refers to items in Fig. 20 .

1. **Ribbed belt**
   - Mark direction of engine rotation before removing
   - Removing and installing: See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
   - Vehicles with A/C with additional idler pulley, removing and installing: See **Pulley, removing and installing**
2. **10 N.m (7ft lb) plus additional 1/4 turn (90°)**
3. **Belt pulley/vibration damper**
   - Can only be installed in one position; holes are offset
4. **25 N.m (18 ft lb)**
5. **Tensioning element**
   - For V-belt
   - Turn with open-end wrench to loosen ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**

6. **Generator**
7. **Assembly bracket**
    - for injection pump, Generator and power steering pump
    - for vehicles with A/C
    - Assembly bracket for vehicles with A/C, removing and installing:

    See **1.9L4-CYLINDER TDI ENGINE**

8. **45 N.m (33 ft lb)**
9. **Banjo bolt**
    - 30 N.m (22 ft lb)
10. **Seal**
    - Always replace
11. **Pressure accumulator**
12. **Flange**
    - For power steering
    - Removing and installing:

    See **POWER STEERING PUMP IN LOWER SECTION, ASSEMBLY OVERVIEW** or **POWER STEERING PUMP IN UPPER SECTION, ASSEMBLY OVERVIEW**

13. **Pulley**
    - For Engine Coolant pump

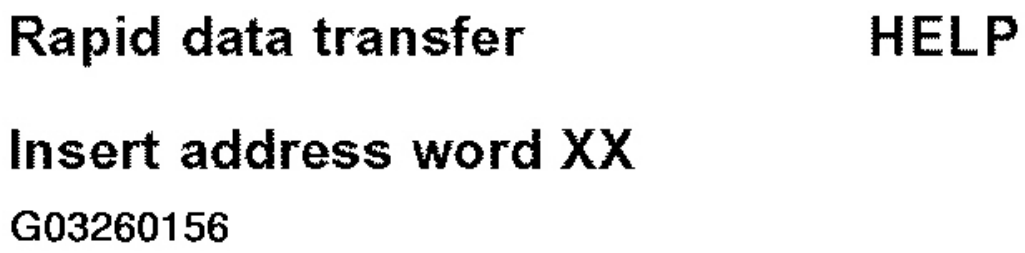


Fig. 20: Identifying Engine Components - Accessory Drive (Part 1)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Pulley, removing and installing

Only for vehicles with A/C

Removing

- Remove sound dampener tray

  See **NOISE INSULATION, ASSEMBLY OVERVIEW** .

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Pry off cover -1- using screwdriver.
- Remove mounting bolts -2- and remove pulley -3-.

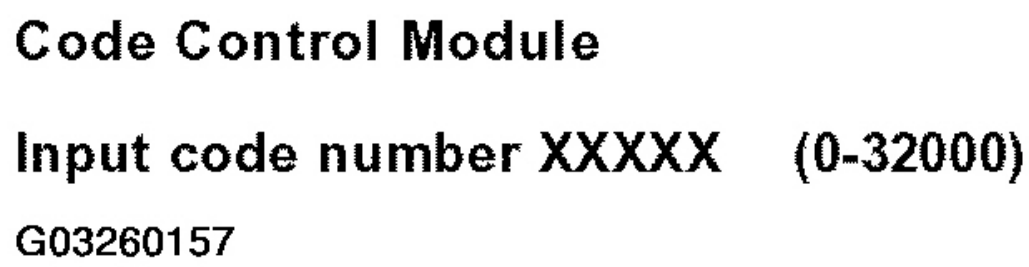


Fig. 21: Removing Ribbed Belt Pulley (Vehicles with A/C)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

- Position pulley -3- and tighten mounting bolt
  - Tightening torque 25 N.m (18 ft lb)
- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
- Install sound dampener tray.

  See **NOISE INSULATION, ASSEMBLY OVERVIEW**

Part II

NOTE: The following list refers to items in Fig. 22 .

1. **120 N.m (88 ft lb) plus additional 1/4 turn (90°)**
   - Always replace
   - To loosen and tighten, counter-hold with 3099
   - Threads and shoulder must be free of oil and grease
   - The additional quarter turn can be obtained in several stages.

2. **40 N.m (30 ft lb) plus additional 1/4 turn (90°)**
    - Always replace
3. 15 N.m (11 ft lb)
4. 22 N.m (16 ft lb)
5. **Toothed belt guard, lower section**
6. **10 N.m (7 ft lb)**
7. **Toothed belt guard**
8. **45 N.m (33 ft lb)**
9. **Right engine bracket**
10. **Toothed belt guard, upper section**
11. **Toothed belt**
    - Mark engine direction of rotation before removing
    - Check for wear
    - Do not kink
    - Removing, installing and tensioning. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING** .
12. **Idler wheel**
13. **20 N.m (15 ft lb) plus additional 1/4 turn (90°)**
    - Always replace
14. **20 N.m (15 ft lb)**
15. **20 N.m (15 ft lb)**
16. **45 N.m (33 ft lb)**
17. **Camshaft sprocket**
    - Drive camshaft off of taper using hammer and drift through toothed belt guard openings
    - to loosen and tighten bolt (item 16), counterhold using 3036
18. **Tensioning roller**
    - Semi-automatic toothed belt tensioning roller, checking. See **SEMI-AUTOMATIC TOOTHED BELT TENSIONING ROLLER, CHECKING** .
19. **Idler wheel**
20. **Injection pump sprocket**
    - Two piece construction
21. **30 N.m (22 ft lb)**
22. **Toothed belt guard, rear**
23. **Coolant pump**
    - Removing and installing. See **COOLANT PUMP, REMOVING AND INSTALLING** .
24. **Idler wheel**
    - First remove, to remove coolant pump
    - Removing and installing. See **COOLANT PUMP, REMOVING AND INSTALLING**

25. **Crankshaft toothed belt sprocket**
26. **Bushing**
27. **Diesel injection pump**
    - Removing and installing

    See **DIESEL INJECTION PUMP, SERVICING** .

28. **Assembly bracket**
    - for Diesel injection pump, Generator and power steering pump.
    - for vehicles with A/C
    - Removing and installing

    See **1.9L4-CYLINDER TDI ENGINE** .

29. **45 N.m (33 ft lb)**

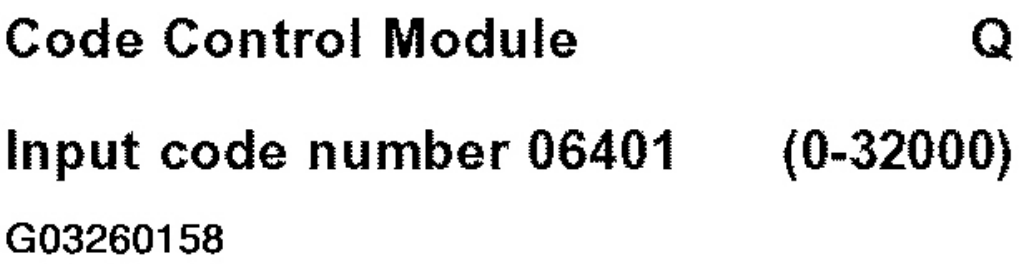


Fig. 22: Identifying Front Engine Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Ribbed belt tensioner, removing and installing

Work sequence

- Remove right-hand insulation tray:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Remove pipe between charge air cooler and turbocharger. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING** .
- Mark engine direction of rotation on ribbed belt.
- Swing tensioning roller in direction of arrow using 15 mm open end wrench on tensioning lever.

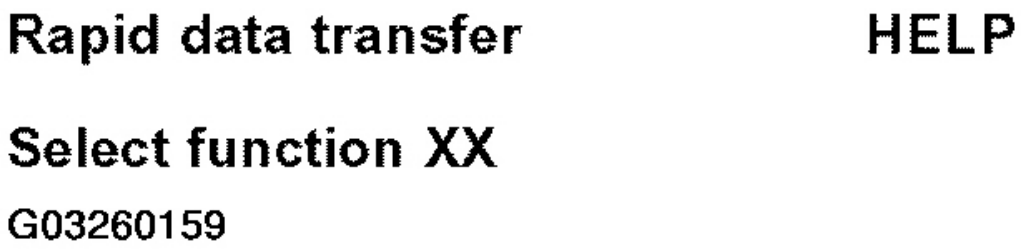


Fig. 23: Removing Or Installing Ribbed Belt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove or install ribbed belt.

NOTE:

- **Vehicles without A/C: first remove V-belt from Generator and position it last when installing.**
- **Vehicles with A/C: first remove V-belt from pulley and position it last when installing.**
- **When installing V-belt; make sure belt sits correctly in pulley.**

Ribbed belt, routing

Belt drive without A/C compressor

NOTE: The following list refers to items in Fig. 24 .

1. Vibration damper/pulley
2. Tensioner
3. Pulley - Generator
4. Ribbed belt
5. Pulley - Power steering pump

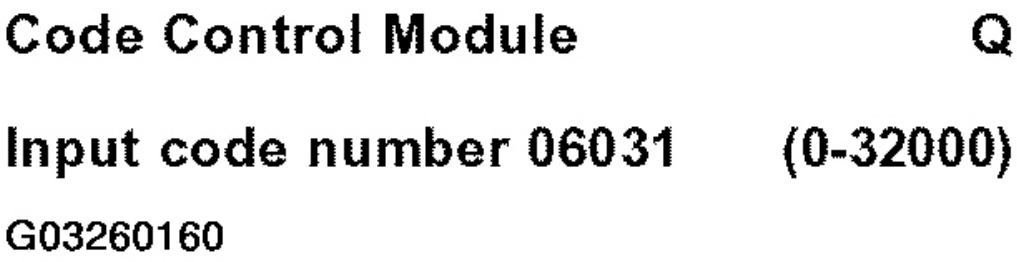


Fig. 24: View Of Belt And Pulleys
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Belt drive with A/C compressor

NOTE: The following list refers to items in Fig. 25 .

1. Vibration damper/pulley
2. Tensioner
3. Pulley - Generator
4. Pulley - Power steering pump
5. Tensioner
6. Ribbed belt
7. Pulley - A/C

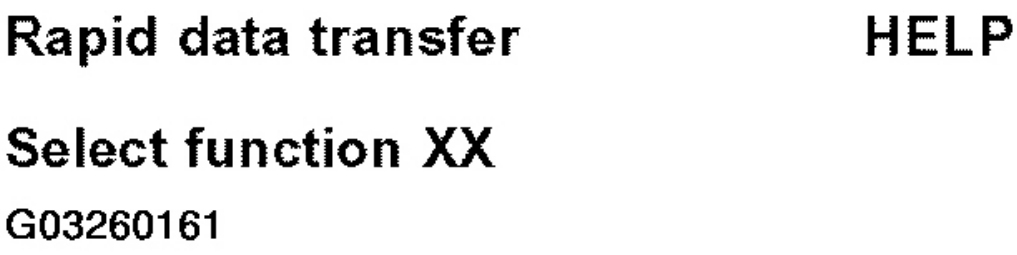


Fig. 25: Identifying Belt Drive With A/C Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Toothed belts, removing, installing, tensioning

Special tools and equipment

- 2068 A Adj. gauge TDC tool
- 3359 Rig pin
- 3418 Adjustment guide
- 10-222A Engine support bridge with 10-222A/1 bracket for engine
- V159 nut wrench
- VAG 1331 Torque wrench: 5 to 50 N.m (3.7 to 37 ft lb)

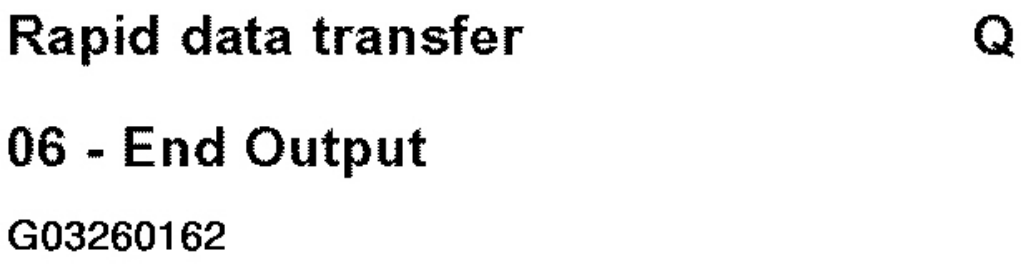


Fig. 26: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Support tool 10-222 A/21, modifications

NOTE:

- **Use tool 10-222A to support the engine / transmission assembly.**
- **Drill a new hole in the 10-222 A/21 guide to fasten 10-222 A/8 adaptor to.**

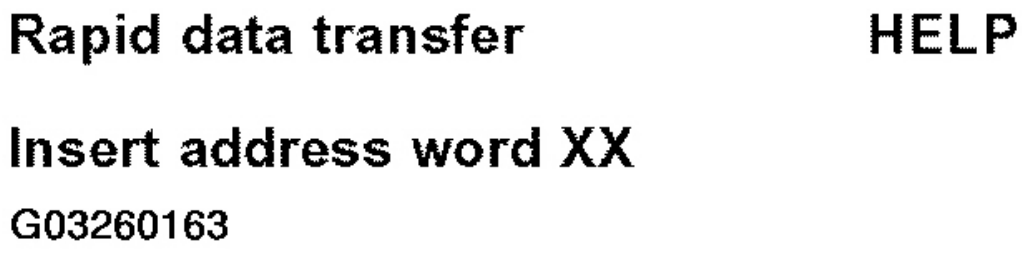


Fig. 27: Identifying New Hole On 10-222 A/21 Guide
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- **Dimensions given are in mm.**
- **One hole 12.5 mm diameter (arrow) drilled in the 10-222 A/21 guide**

Toothed belts, removing

- Remove tube between charge air cooler and Air intake pipe. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING**
- Disconnect fuel supply and return lines at fuel filter.
- Remove fuel filter from bracket.
- Remove toothed belt guard - upper section.
- Remove valve cover.

NOTE: The valve cover has an integrated, vulcanized gasket. If damaged or leaking replace the valve cover.

- Remove brake booster vacuum pump.
- Remove pipe between charge air cooler and turbocharger. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING** .
- Remove insulation tray - right side

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .

With engine installed:

- Turn crankshaft to cylinder 1 TDC.

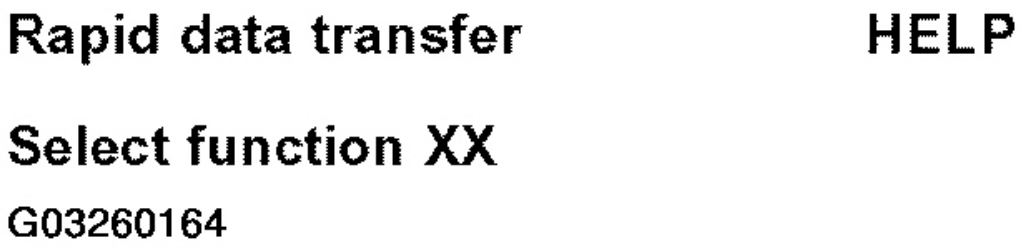


Fig. 28: Identifying Timing Mark (Manual Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to cylinder 1 TDC.

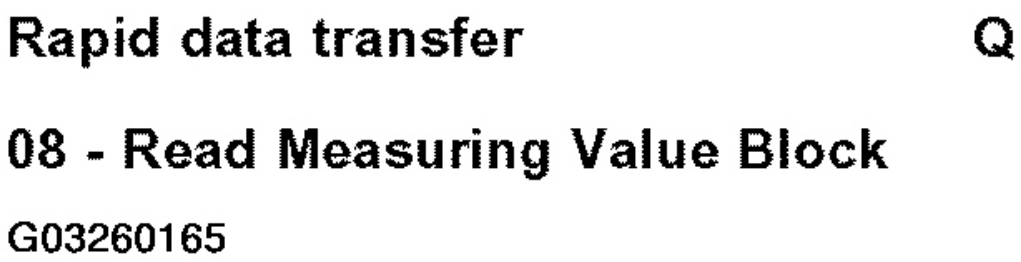


Fig. 29: Identifying Timing Mark (Automatic Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

With engine removed:

Vehicles with manual transmission

- Install adjustment device 2068 A as shown.

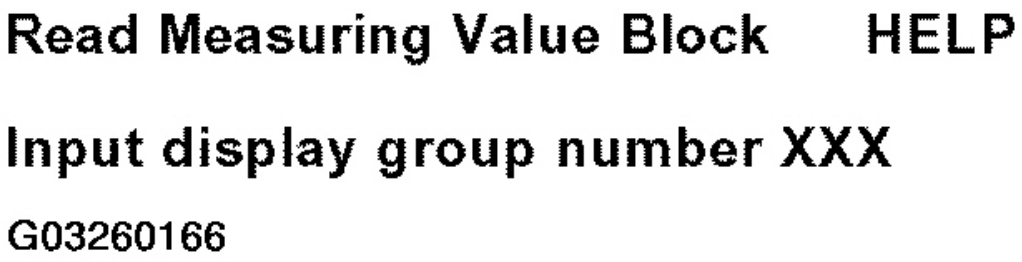


Fig. 30: Installing Adjustment Device On Flywheel
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Set adjustment device to 96 mm (arrow -A-). Left-hand notch of vernier scale is reference point.
- Turn crankshaft until flywheel TDC marking aligns with point on setting device (arrow -B-).

Vehicles with automatic transmission

- Install adjustment device 2068 A as shown.

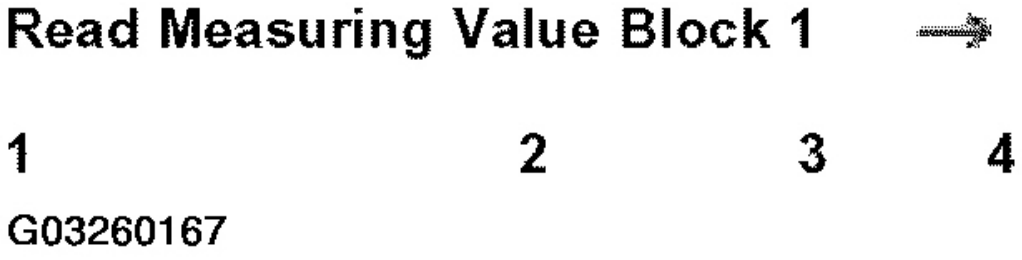
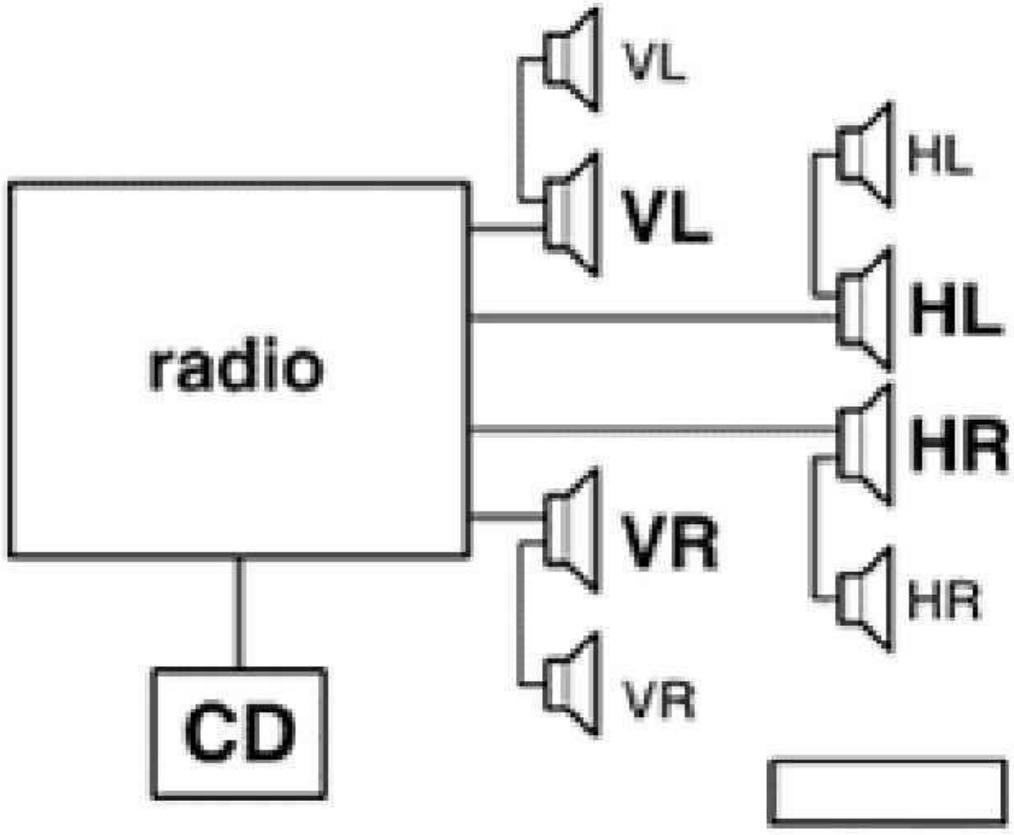


Fig. 31: Installing Adjustment Device On Flywheel
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Set adjustment device to 96 mm (arrow -A-). Left-hand notch of vernier scale is reference point.
- Turn crankshaft until flywheel TDC marking aligns with point of setting device (arrow -B-).

All vehicles

- Lock camshaft using setting bar.



VL = Left front

HL = Left rear

VR = Right front

HR = Right rear

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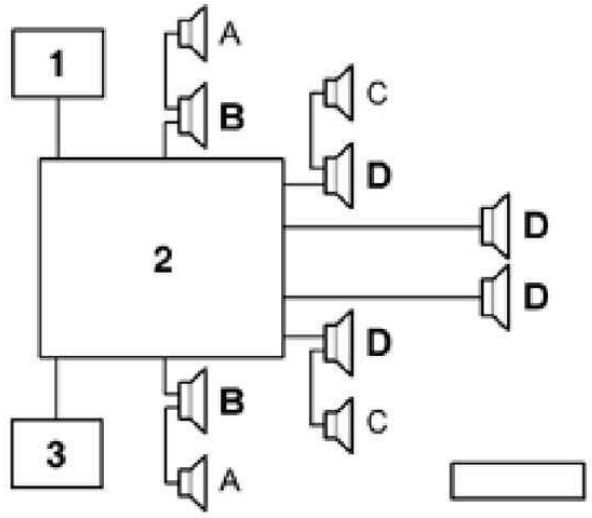
Fig. 32: Installing Setting Bar On Camshaft
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Centralize setting bar as follows:

  Turn camshaft so that one end of setting bar contacts the cylinder head. Using feeler gauge establish the gap at the other end of the setting bar. Place a feeler gauge corresponding to half the gap between setting bar and cylinder head. Turn camshaft until the setting bar contacts the feeler gauge. Place a 2nd feeler gauge, of same thickness, at the other end between setting bar and cylinder head

- Lock injection pump sprocket with pin.
- Loosen injection pump sprocket mounting bolts -1-.



1 - Amplifier

2 - Radio Monsoon

3 - CD player

A - Domed treble loudspeaker in inner plenum chamber cover

B - Bass loudspeaker in inner plenum chamber cover

C - Domed treble loudspeaker in A-pillar trim

D - Bass loudspeaker, front and rear in side panel trim

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Fig. 33: Locking Injection Pump Sprocket With Pin
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: **Do NOT loosen hub nut -2-! Otherwise the Diesel injection pump basic setting will be altered and cannot be reset with normal workshop equipment.**

- Loosen tensioner.
- Install 10-222A support with 10-222A/1 legs as shown.

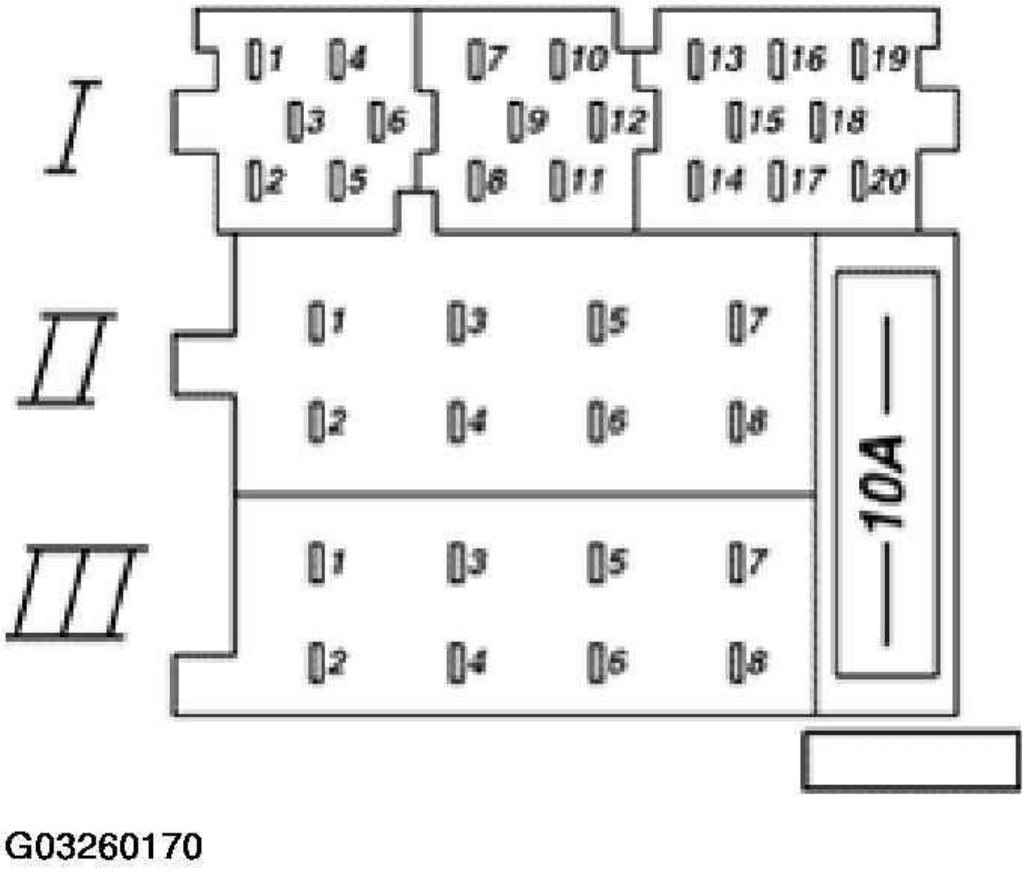


Fig. 34: Installing 10-222A Support With 10-222A/1 Legs
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove engine mount -1- as follows:
- Unscrew bolts (arrows)

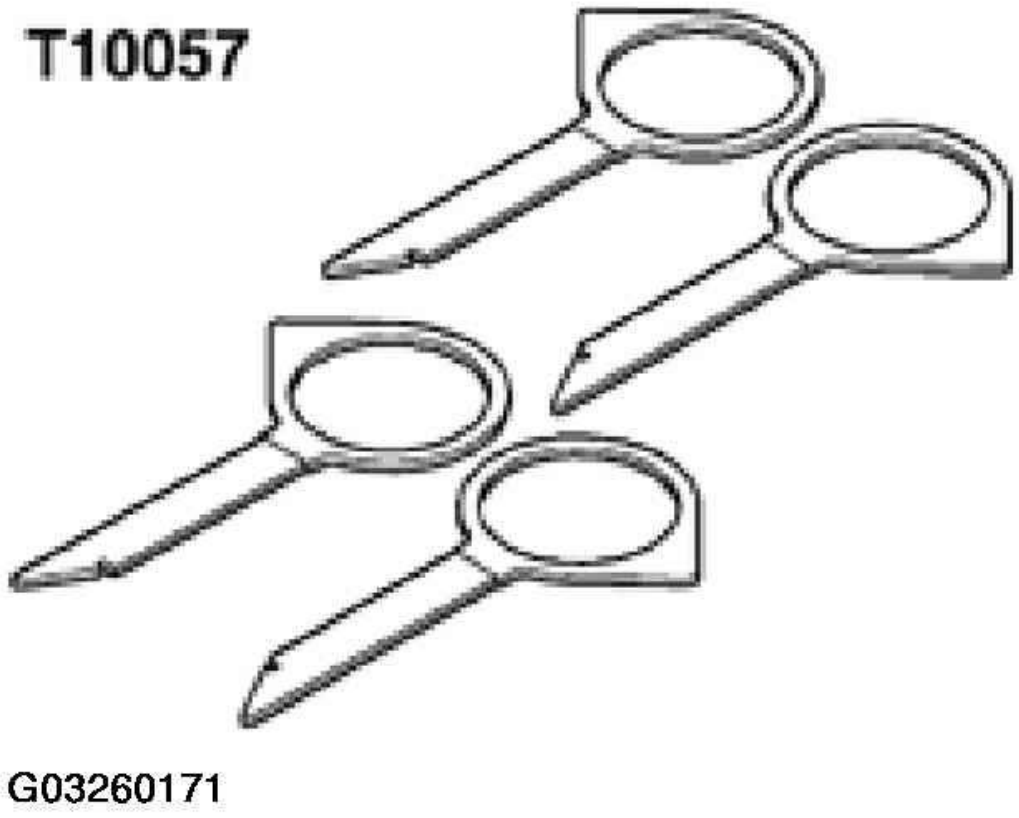


Fig. 35: Removing Engine Mount
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove vibration damper/belt pulley.
- Remove toothed belt guard center and lower sections.
- Mark engine direction of rotation on the toothed belt.
- Remove toothed belt.

Toothed belts, installing

- Make sure that TDC mark on flywheel and reference mark are aligned.
- Loosen camshaft sprocket mounting bolt 1/2 turn.
- Place a drift through hole in rear of toothed belt guard and release the camshaft sprocket from camshaft taper with a light and careful hammer blow.

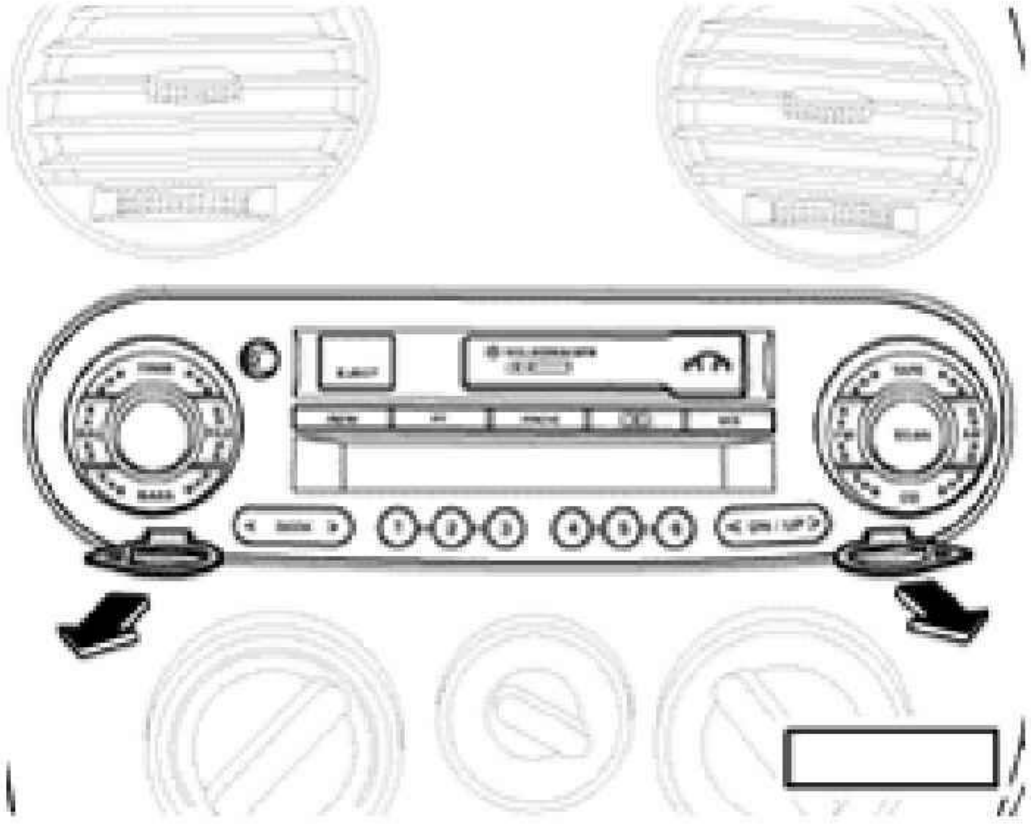


Fig. 36: Installing Drift Through Hole In Rear Of Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install toothed belts (note engine direction of rotation) on crankshaft toothed belt sprocket, intermediate wheel, injection pump sprocket and tensioning roller.
- Install camshaft sprocket together with toothed belt and position using mounting bolt.
  - Camshaft sprocket should still turn
- Tension toothed belt; using pin wrench on eccentric, turn clockwise until notch and raised mark align (arrows).

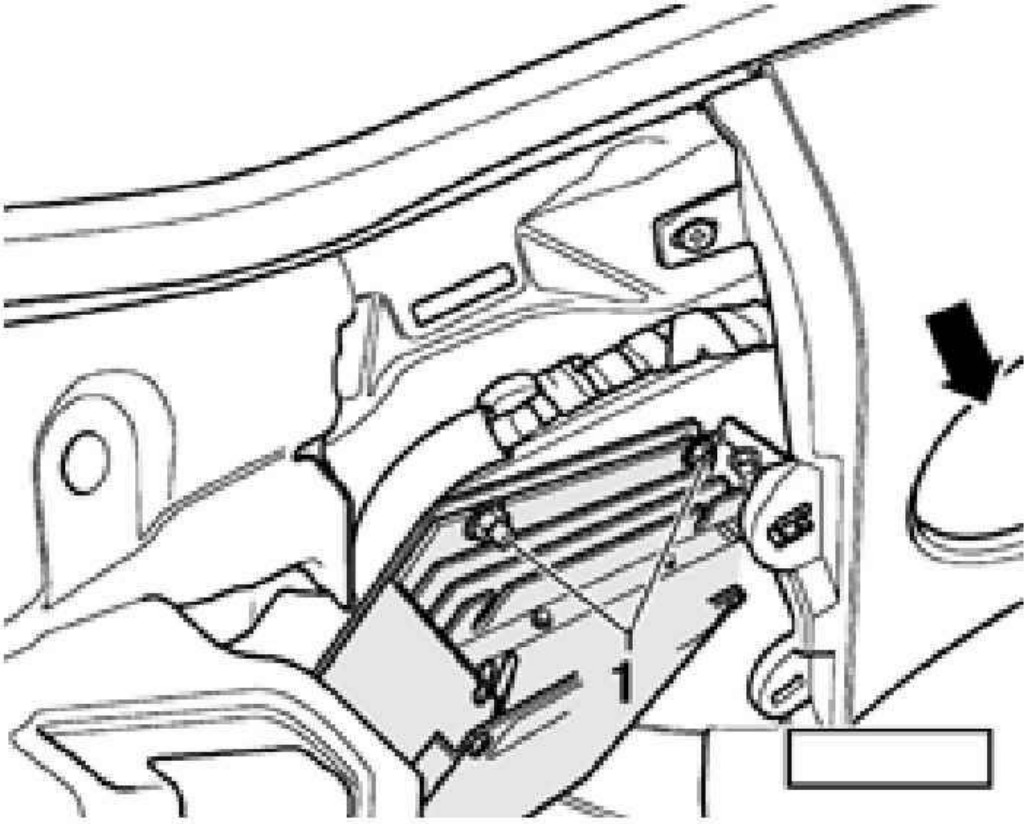


Fig. 37: Tightening Lock Nut On Tensioning Roller
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten lock nut on tensioning roller.
  - Tightening torque: 20 N.m (15 ft lb)

NOTE: Observe correct installation of tension roller in rear toothed belt guard (arrow).

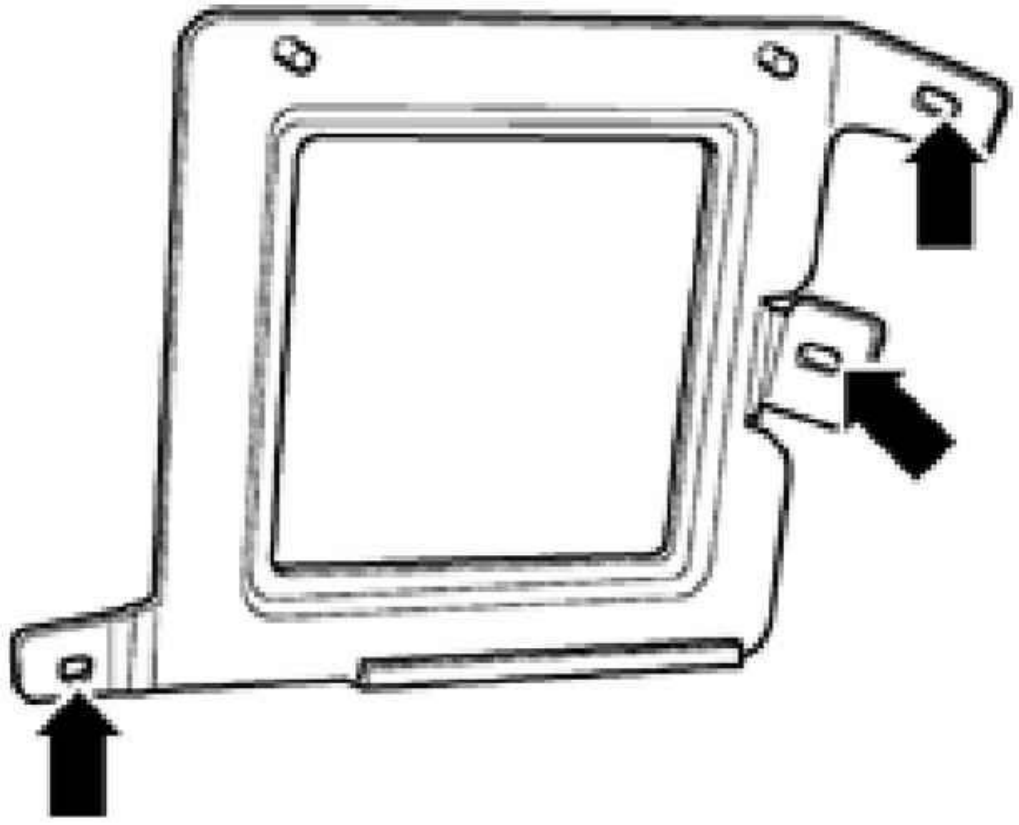


Fig. 38: Identifying Correct Installation Of Tension Roller
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check TDC mark on flywheel again.
- Tighten camshaft sprocket mounting bolt.
  - 45 N.m (33 ft lb)
- Tighten the new mounting bolts of injection pump sprocket
  - Tightening torque: 20 N.m (15 ft lb)

NOTE:

- **After dynamically checking the "start of injection", the mounting bolts must be retightened 90° (1/4 turn).**

See DIESEL INJECTION PUMP, REMOVING AND INSTALLIN

- **The mounting bolts should only be used one time, since by design they have a reduced shank**

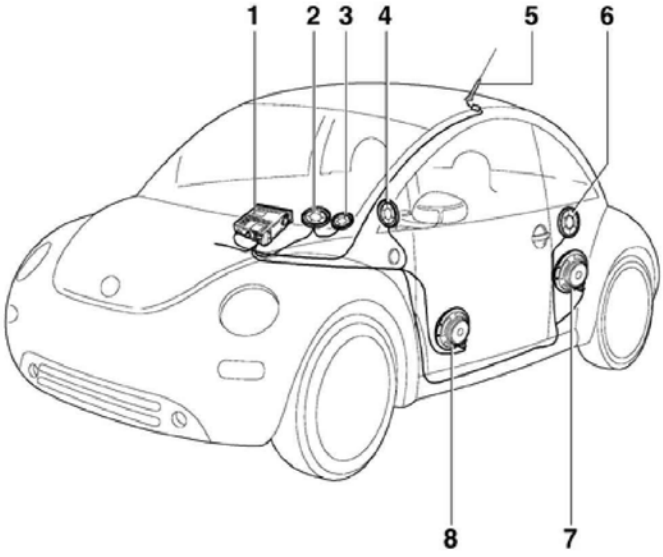
- Remove 2065A setting bar from camshaft.
- Remove pin.
- Turn crankshaft two rotations in engine direction of rotation and set again to cylinder 1 TDC.
- Attach bracket to engine block.
- Install engine mount (replace mounting bolts).
  - Tightening torque: 40 N.m (30 ft lb) plus additional 90° (1/4 turn)
- Securely install mount for engine to engine bracket (replace mounting bolts)
  - Tightening torque: 60 N.m (44 ft lb) plus additional 90° (1/4 turn)
- Install bracket for subassembly/body
  - Tightening torque: 25 N.m (18 ft lb)
- Install vacuum pump.
- Install toothed belt guard, vibration damper, belt pulley, and valve cover.
- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Install sound dampening tray and engine cover
- Remove pipe between charge air cooler and turbocharger. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING** .
- Install fuel filter with bracket
- Disconnect fuel supply and return lines at fuel filter.
- Install pipe between charge air cooler and intake pipe. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING** .
- Check Diesel injection pump "start of delivery"

  See **START OF INJECTION, DYNAMICALLY CHECKING AND ADJUSTING**

Semi-automatic toothed belt tensioning roller, checking

Test sequence

- Tighten toothed belt with firm thumb pressure.



1 - Radio

- In center console
- Removing and installing ⇒ Page 91-10

2 - Bass loudspeaker (with Monsoon only)

- In inner plenum under cover
- Removing ⇒ Page 91-22

3 - Domed treble loudspeaker (with Monsoon only)

- In inner plenum under covcer
- Removing ⇒ Page 91-22

4 - Domed treble loudspeaker

- In A-pillar
- Removing ⇒ Page 91-20

5 - Roof antenna

- Amplified mast type antenna mounted on roof ⇒ Page 91-29

6 - Not applicable

7 - Bass loudspeaker

- In rear side panel
- Removing and installing ⇒ Page 91-21

8 - Bass loudspeaker

- In front door
- Removing and instaling ⇒ Page 91-21

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Fig. 39: Tightening Toothed Belt Nut
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Notch and raised portion (arrows) must move apart.

- Release thumb pressure on toothed belt.

Tensioning roller must move back to its initial position, notch and raised portion must align again.

SEALING FLANGE AND FLYWHEEL/DRIVE PLATE, REMOVING AND INSTALLING

NOTE: For clutch repairs: See CLUTCH ASSEMBLY

NOTE: The following list refers to items in Fig. 40 .

1. **15 N.m (11 ft lb)**
2. **Oil seal**
   - Replacing. See **SEALING RING (CRANKSHAFT PULLEY SIDE), REPLACING**
3. **Sealing flange, front**
   - Must be located on dowel sleeves
   - Removing and installing. See **SEALING FLANGE (FRONT), REMOVING AND INSTALLING**
4. **Engine block**
   - Crankshaft, removing and installing. See **CRANKSHAFT, REMOVING AND INSTALLING**
   - Pistons and connecting rods, disassembling and assembling. See **PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING**
5. **Flywheel/drive plate**
   - to remove and install flywheel, counter-hold using 3067
   - Drive plate, removing and installing: See **DRIVE PLATE, REMOVING AND INSTALLING**
6. **60 N.m (44 ft lb) plus additional 1/4 turn (90°) further**
   - Always replace
7. **Intermediate plate**
   - Must be located on dowel sleeves
   - Do not damage/bend when assembling
8. **Sealing flange with oil seal**
   - Only replace as an assembly
   - Lightly oil sealing lip on oil seal

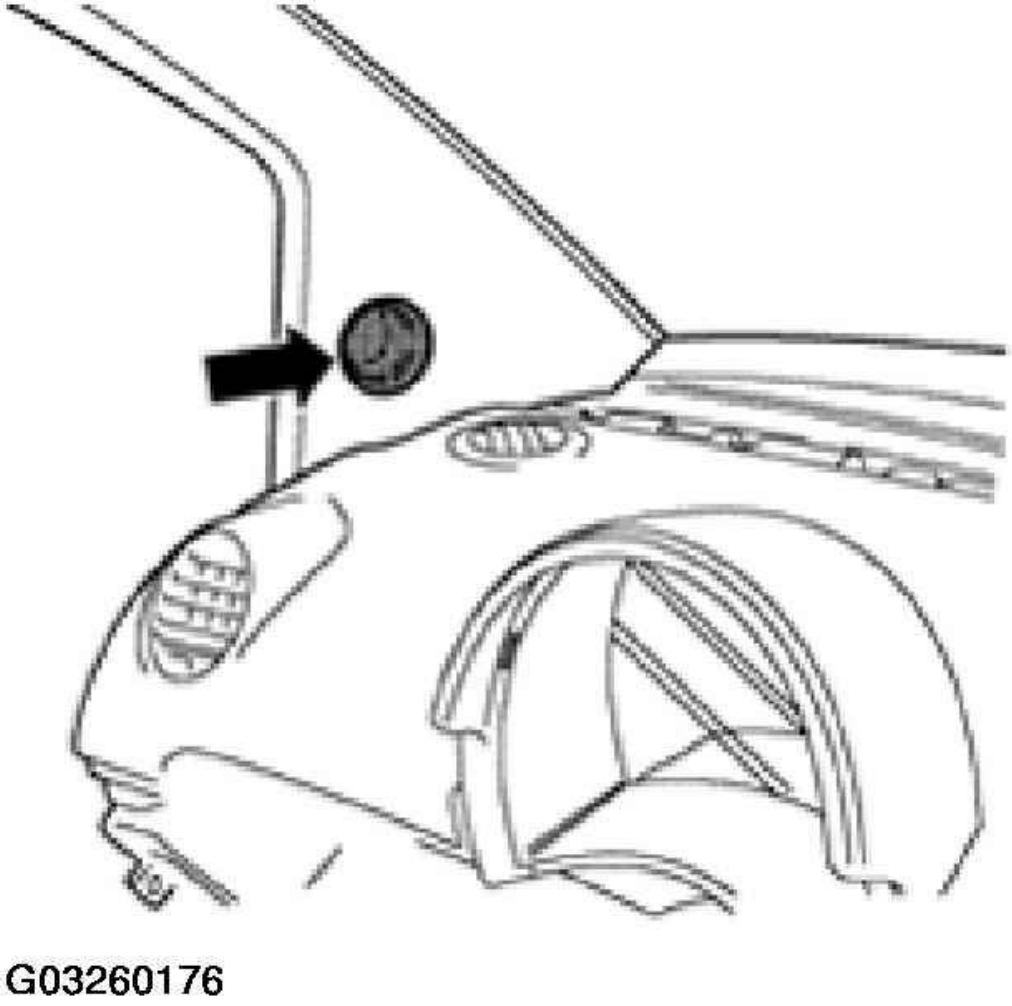

Fig. 40: Identifying Sealing Flange And Flywheel/Drive Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Sealing ring (crankshaft pulley side), replacing

Special tools and equipment

- 2080 A sleeve
- 3415 Counter support
- 3203 Seal remover
- 3265 Sleeve installer

- VAG 1331 Torque wrench: 5 to 50 N (3.7 to 37 ft lb)
- VAG 1332 Torque wrench: 40 to 200 N.m (30 to 148 ft lb)

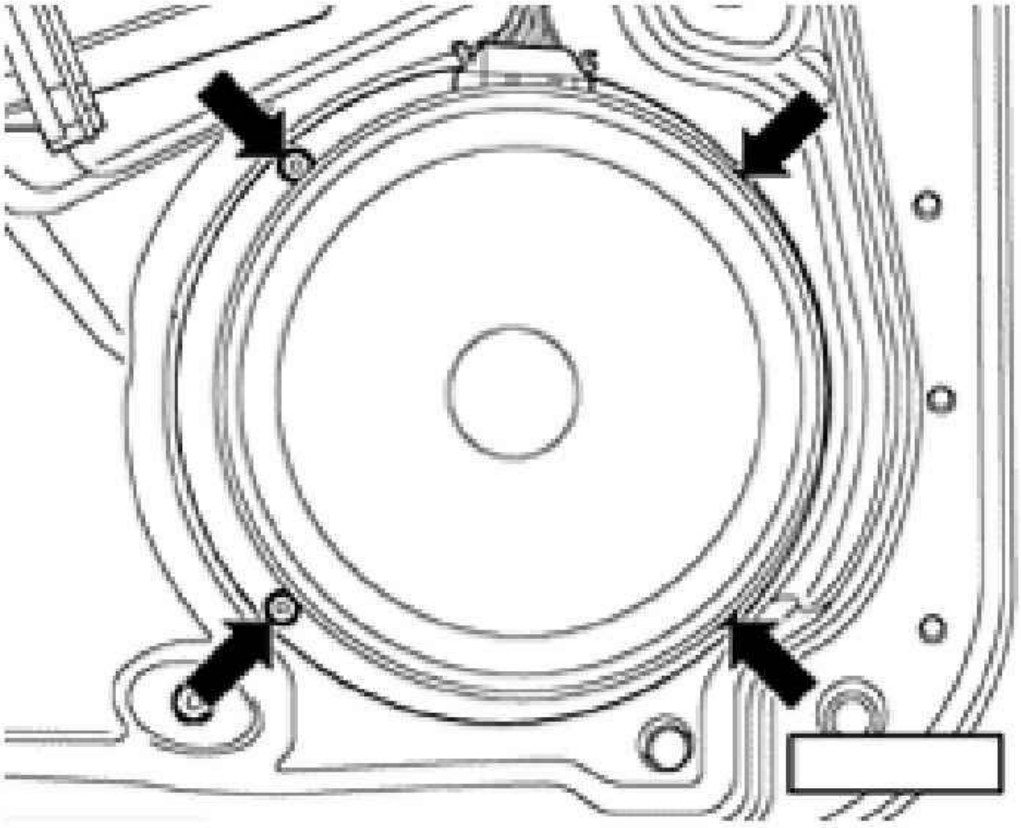

Fig. 41: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING** .
- Remove toothed belt. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING** .
- Remove crankshaft toothed belt sprocket by counter-holding sprocket using 3415.

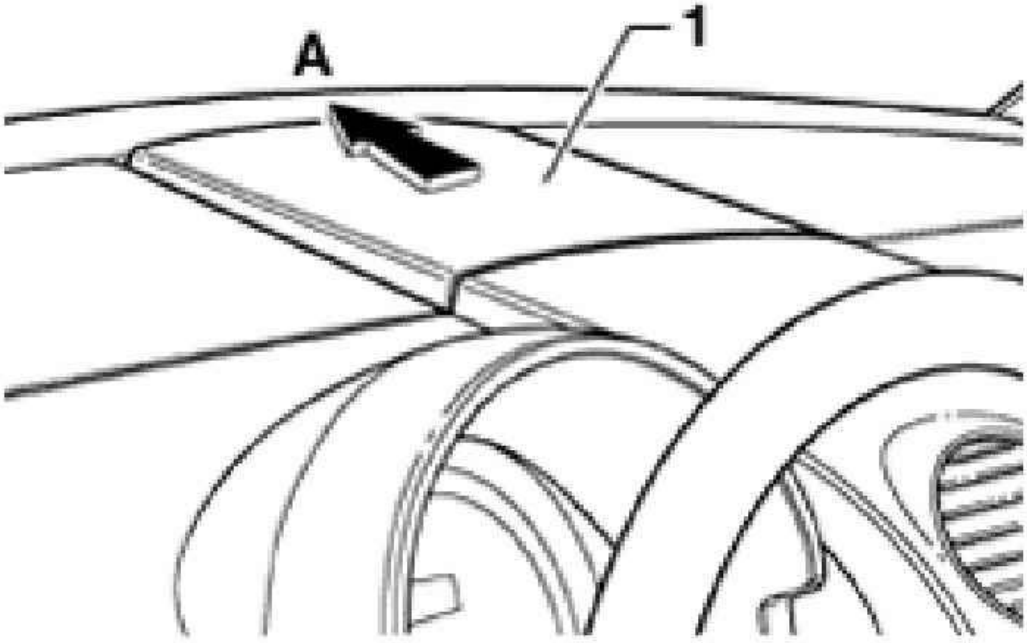

Fig. 42: Removing Crankshaft Toothed Belt Sprocket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- To guide seal extractor, hand screw center bolt into crankshaft onto stop.
- Unscrew inner part of oil seal extractor 3203 two turns (approx. 3 mm) out of outer part and lock with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and while exerting firm pressure, screw it in as far as possible into the oil seal.

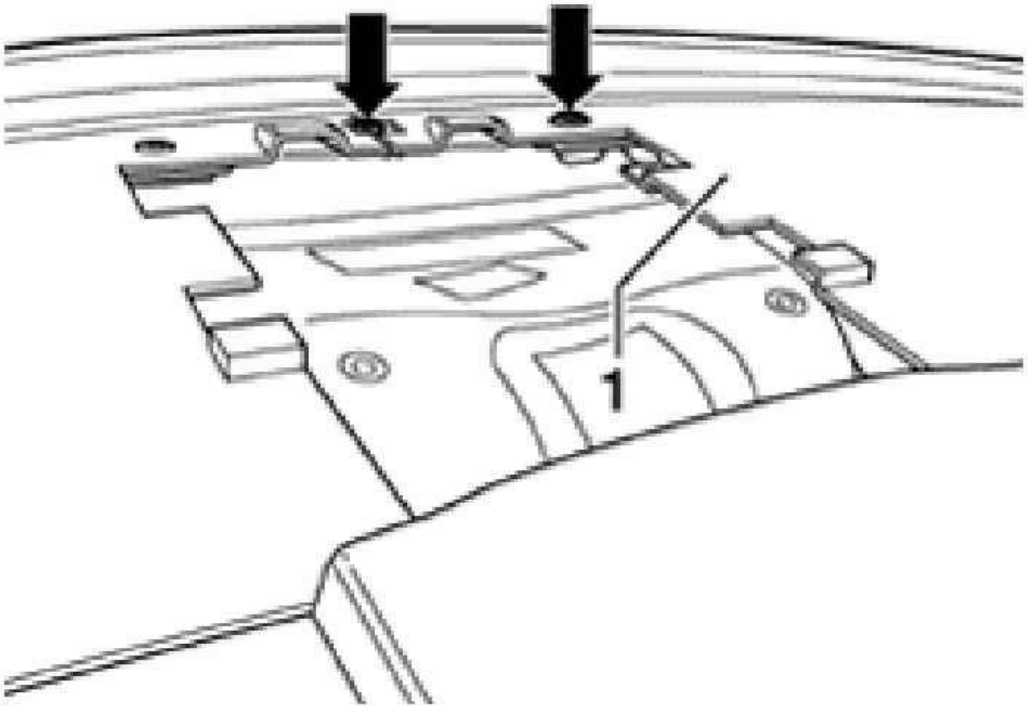

Fig. 43: Removing Oil Seal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.

Installing

- Lightly oil sealing lip of oil seal.
- Install guide sleeve from 2080 A onto crankshaft journal.

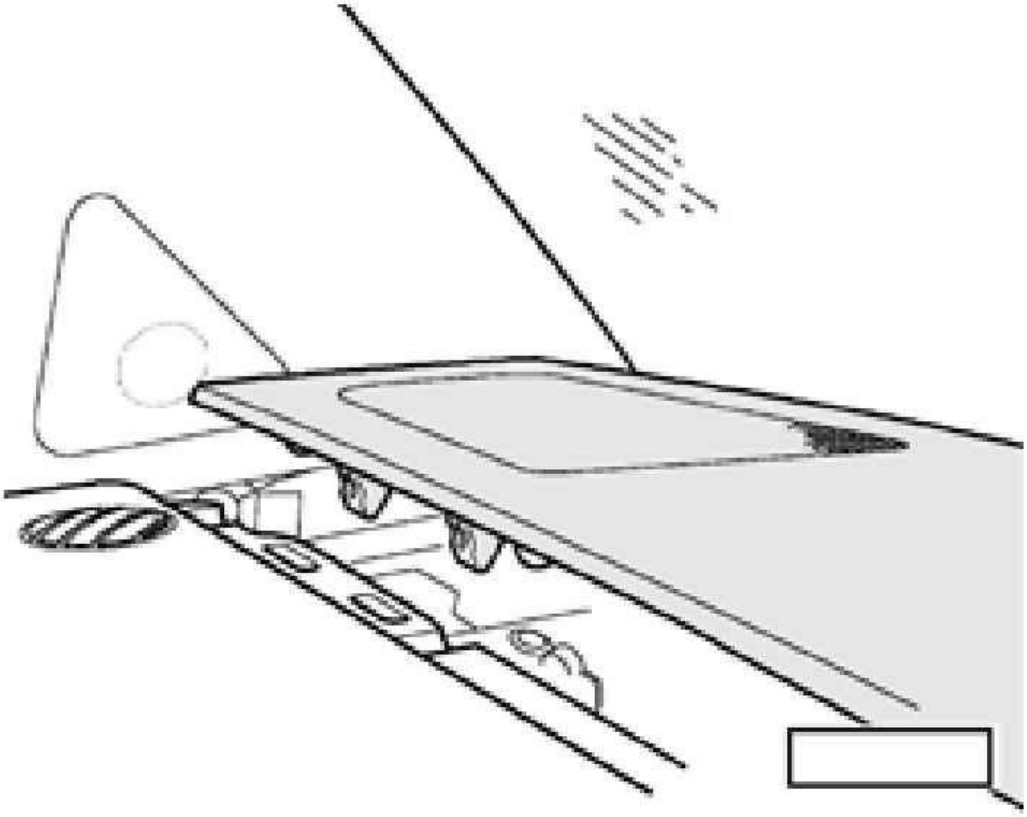

Fig. 44: Installing Guide Sleeve Onto Crankshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve.
- Press in sealing ring with press sleeve from 3265 up to the stop using center bolt -1-

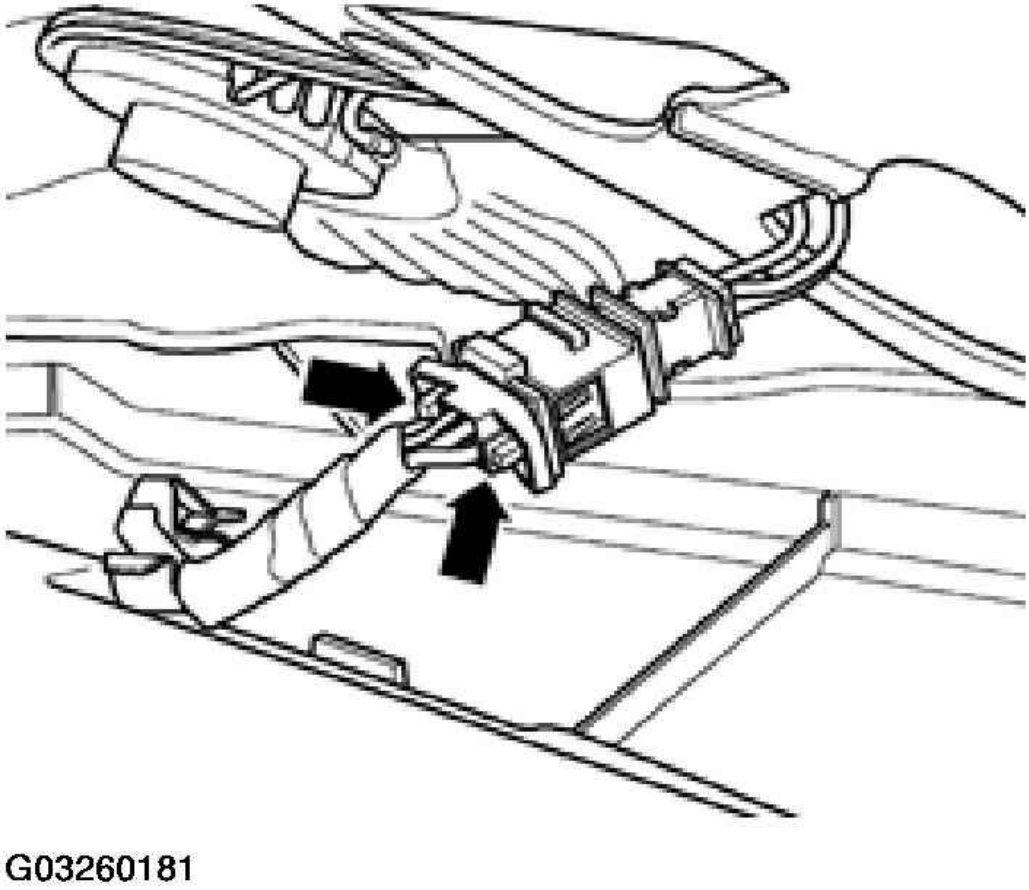

Fig. 45: Installing Sealing Ring
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install crankshaft toothed belt sprocket and hold using 3099 counterhold.
- Install toothed belt and tension. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**

Drive plate, removing and installing

Special tools and equipment

- VW 558 Counter-hold tool
- Hex bolt M8x45 and two M10 hex nuts
- Depth gauge

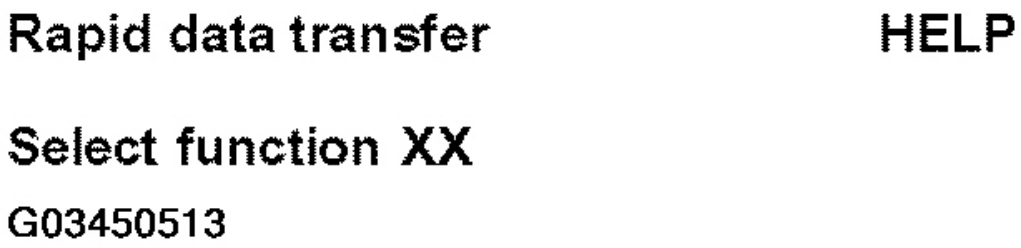

Fig. 46: Identifying VW 558 Counter-Hold Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Drive plate, loosening and tightening

- Secure VW 558 counterhold to drive plate using M8 x 45 hex bolt.
- Place two M10 hex nuts between counterhold and drive plate.

Position of counterhold tool:

- A - To loosen
- B - To tighten

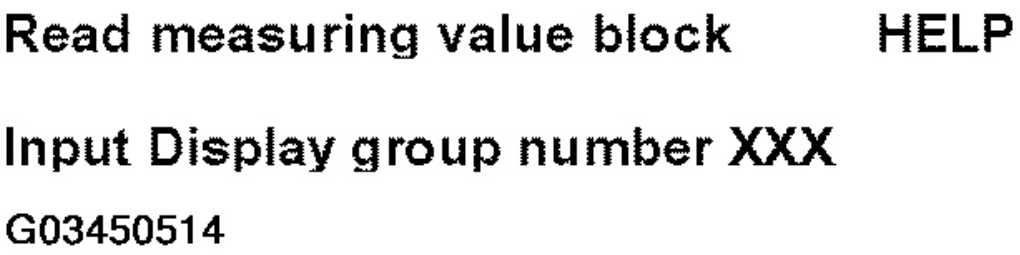

Fig. 47: Holding Drive Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Drive plate, installing

- Position drive plate and backing plate with recesses -1-.

- Install new bolts -3- and tighten.
  - 30 N.m (22 ft lb)

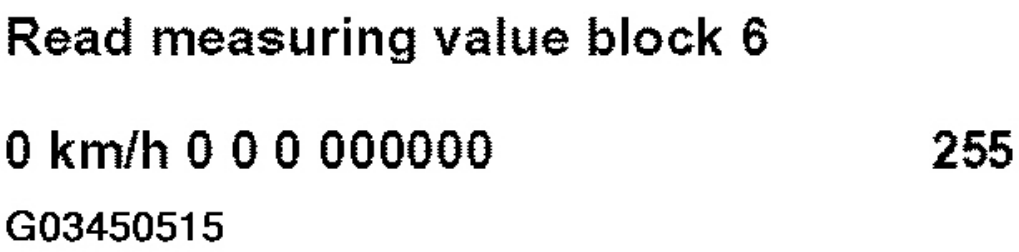

Fig. 48: Installing Drive Plate And Backing Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check dimension -a- at three points and calculate average.

  Specification: 19.5 to 21.1 mm

NOTE: **Because of the hole in the drive plate it is measured on the milled surface of the engine block**

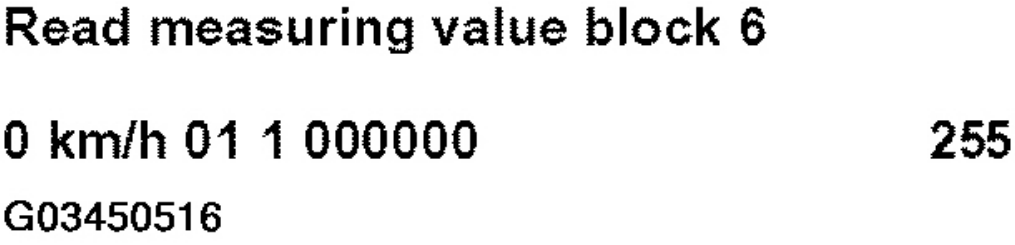

Fig. 49: Checking Drive Plate Installed Dimension
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If specification not obtained

- Remove drive plate and install shim -2-.

- Tighten bolts -3-.
  - 30 N.m (22 ft lb)
- Tighten bolts -3- to 60 N.m (44 ft lb) and turn an additional 90° (1 /4 turn) further.

NOTE: The 1/4 turn additional can be achieved in more than one step.

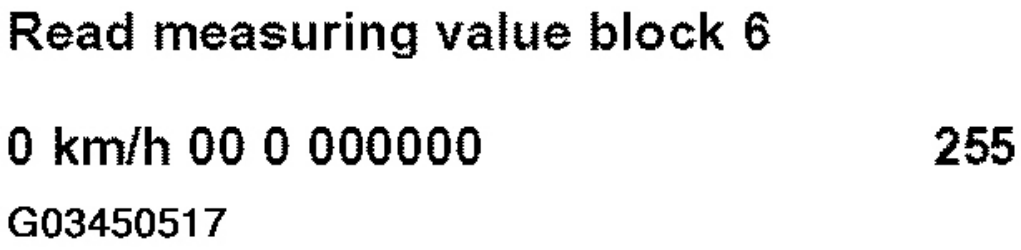

Fig. 50: Installing Drive Plate And Shim
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Sealing flange (front), removing and installing

Special tools and equipment

- 2080 A Sleeve
- 3415 Counter support
- VAG 1331 Torque wrench: 5 to 50 N.m (3.7 to 37 ft lb)
- VAG 1332 Torque wrench: 40 to 200 N.m (30 to 148 ft lb)
- Hand drill w/ plastic brush insert
- D 176 404 A2 Silicone sealant
- Flat scraper

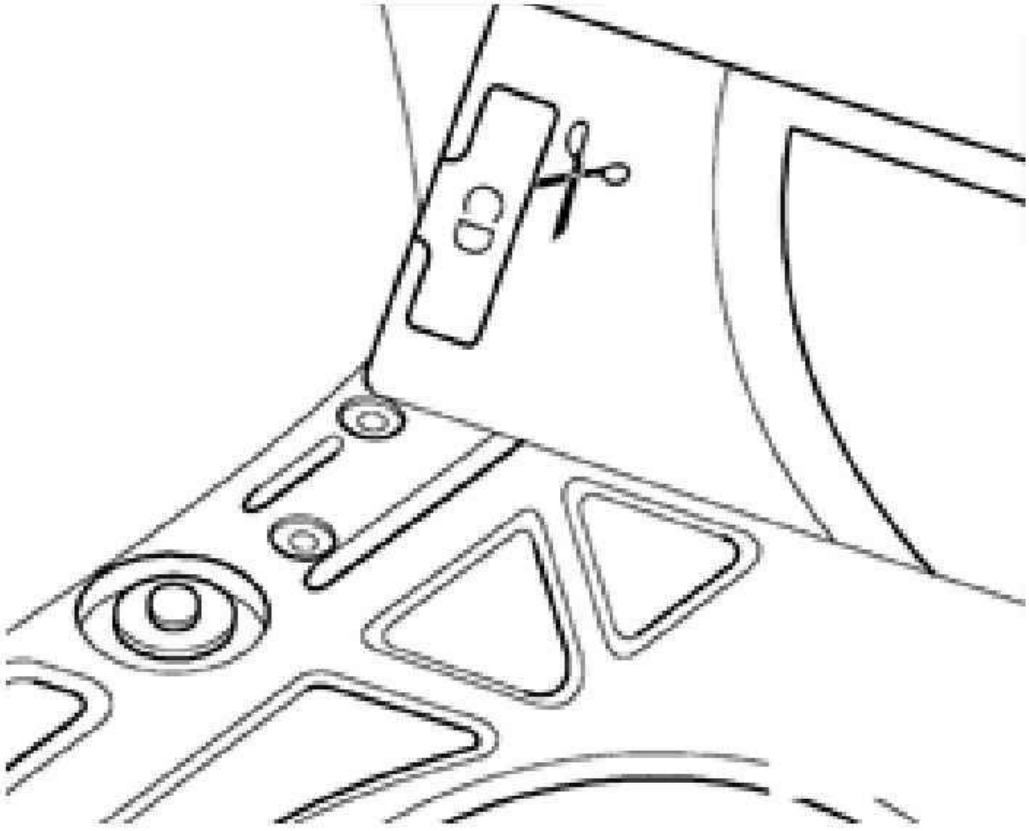

Fig. 51: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
- Remove toothed belt. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
- Remove crankshaft toothed belt sprocket by counter-holding sprocket with 3415.

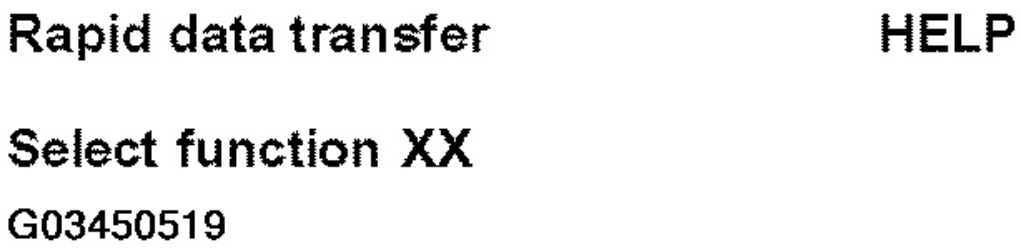

Fig. 52: Removing Crankshaft Toothed Belt Sprocket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Drain engine oil.
- Remove oil pan. See **OIL PAN, REMOVING AND INSTALLING**
- Unbolt front sealing flange.
- Remove sealing flange and if necessary, release using light blows with a rubber hammer.
- Remove sealant residue on engine block with a flat scraper.
- Remove sealant remains on sealing flange with a rotating plastic brush (wear protective goggles).

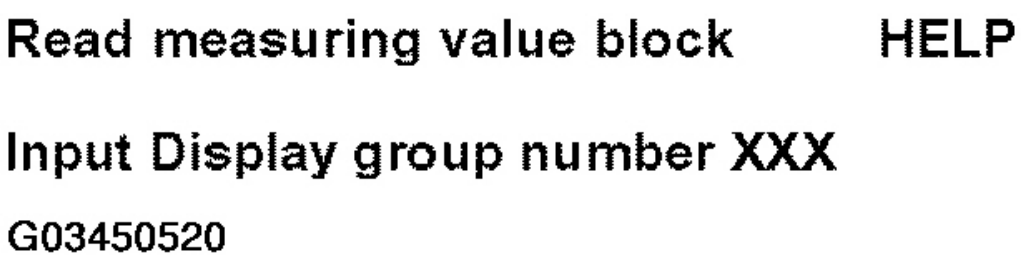

Fig. 53: Removing Sealant Remains On Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Clean sealing surface.

NOTE: Surface must be free of oil and grease

Installing

NOTE:

- **Observe the "must be used by" date on the sealant tube.**
- **Oil pan must be installed within 5 minutes after applying silicone sealing compound.**

- Cut off tube nozzle at forward mark (nozzle approx. 3 mm diameter)
- Apply silicone sealing compound, as shown, to a clean oil pan sealing surface.
  - Thickness of sealant bead must be (arrows): 2 to 3 mm

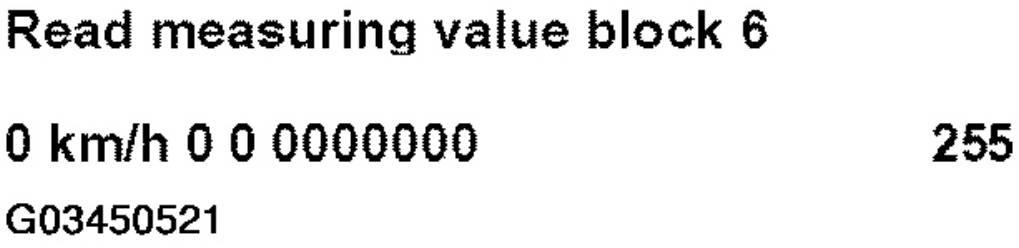

Fig. 54: Applying Silicone Sealant Bead To Clean Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

CAUTION: The sealing compound bead thickness specification must NOT be thicker, otherwise excess sealing compound will enter the oil pan and could block the oil suction pipe strainer.

- Apply silicone sealant bead as shown to the clean sealing surface of the sealing flange.
- Install sealing flange immediately, then lightly tighten all bolts.

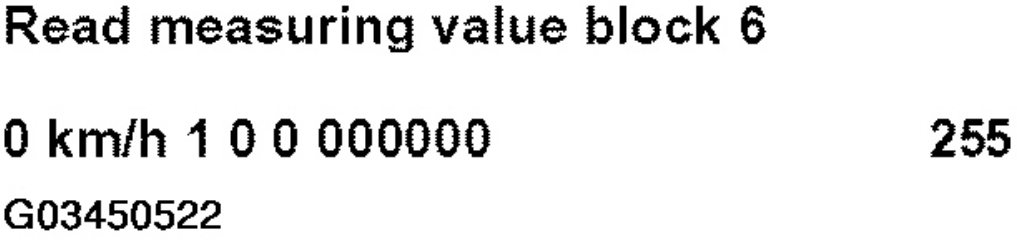

Fig. 55: Applying Silicone Sealant Bead To Clean Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Use guide sleeve from 2080A to install the sealing flange if the oil seal is already installed.

- Tighten sealing flange mounting bolts using a staggered tightening pattern.
  - Tightening torque: 15 N.m (11 ft lb)
- Install oil pan. See **OIL PAN, REMOVING AND INSTALLING**

NOTE: After installing; allow the sealant to dry for approx. 30 minutes before adding engine oil.

- Install toothed belt and adjust timing. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
- Install ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**

CRANKSHAFT, REMOVING AND INSTALLING

NOTE: The following list refers to items in Fig. 56 .

1. **Bearing shells:1, 2, 4 and 5**
   - For bearing caps without oil groove
   - For engine block with oil groove
   - Do NOT interchange used bearing shells (mark)
2. **65 N.m (48 ft lb) plus additional 1/4 turn (90°)**
   - Replace
   - Threaded along complete length of screw
   - To measure radial clearance tighten to 65 N.m (48 ft lb) but no further
3. **Bearing cap**
   - Bearing cap 1: Pulley end
   - Bearing cap 3 with recesses for thrust washers
   - Bearing shell retaining lugs engine block/bearing cap must be on the same side
4. **Bearing shell 3**
   - Bearing cap w/o oil groove
   - For engine block with oil groove
5. **Thrust washer**
   - For bearing cap 3
   - Note fixing arrangement
6. **Sensor wheel**

- For Engine Speed sensor

7. **10 N.m (7 ft lb) plus additional 1/4 turn (90°)**
   - Always replace
8. **Fitted pin**
   - Checking projection from crankshaft. See **Crankshaft dowel pin projection, checking**
9. **Crankshaft**
   - Axial clearance new: 0.07 to 0.17 mm Wear limit: 0.37 mm
   - Check radial clearance with Plastigage New: 0.03 to 0.08 mm Wear limit: 0.17 mm
   - Do not rotate crankshaft when checking radial clearance
   - Crankshaft dimensions. See **CRANKSHAFT DIMENSIONS (MM)**
10. **Thrust washer**
11. For engine block, bearing 3

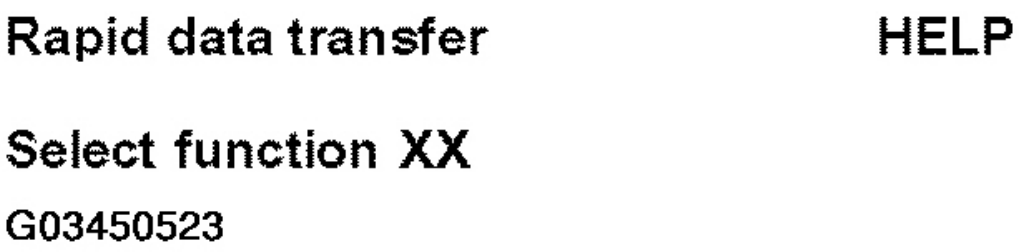

Fig. 56: Exploded View Of Crankshaft & Main Bearing Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Crankshaft dowel pin projection, checking

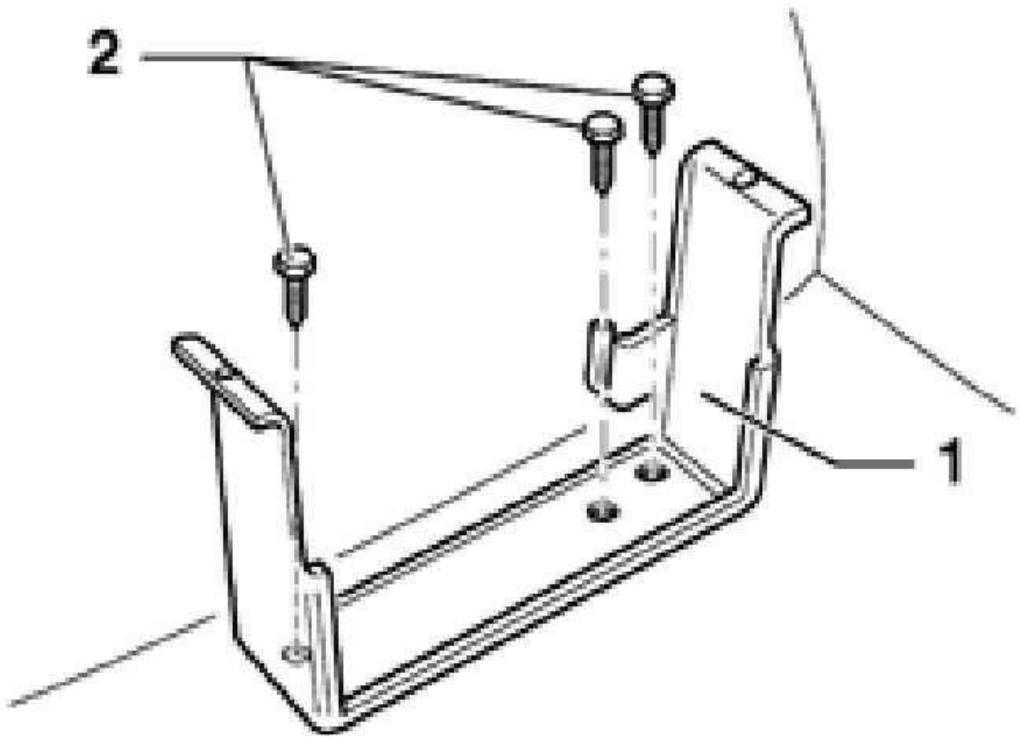

Fig. 57: Checking Crankshaft Dowel Pin Projection
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Dowel pin projection -3- out of crankshaft a = 2.5 to 3.0 mm

Crankshaft dimensions (mm)

CRANKSHAFT DIMENSIONS CHART

Honing dimension	Main journal diameter	Con-rod journal diameter
Basic dimension	-0.022 54.00 -0.042	-0.022 47.80 -0.042
1st undersize	-0.022 53.75 -0.042	-0.022 47.55 -0.042
2nd undersize	-0.022 53.50	-0.022 47.30

	-0.042	-0.042
3rd undersize	-0.022 53.25 -0.042	-0.022 47.05 -0.042

PISTONS AND CONNECTING RODS, DISASSEMBLING AND ASSEMBLING

NOTE: The following list refers to items in Fig. 58 .

1. **Piston ring**
   - Offset ring gaps 120°
   - Remove and install using piston ring pliers
   - "TOP" faces towards crown
   - Ring gap, checking: See **Piston ring gap, checking**
   - Ring to groove clearance. See **Ring to groove clearance, checking**
2. **Piston**
   - Mark installation position and cylinder number
   - Arrow on piston crown points to: pulley end
   - Install using piston ring tool
   - If any cracks on piston skirt, replace piston
   - Piston projection at TDC, checking. See **PISTON PROJECTION AT TDC, CHECKING**
3. **Piston pin**
   - If difficult to remove, heat piston to 60 °C
   - Remove and install using VW 222A
4. **Circlip**
5. **Connecting rod**
   - Only replace as a set
   - Mark cylinder number -A-
   - Installed position: Marking -B- faces pulley end
6. **Fitted pin**
   - Pin must seat securely in connecting rod, not in bearing cap
7. **Bearing shell**
   - Note installed position
   - Do not interchange used bearing shells
   - Make sure retaining lugs fit tightly in recesses
   - Axial clearance Wear limit: 0.37 mm
   - Check radial clearance with Plastigage: Wear limit: 0.08 mm Do not rotate crankshaft while checking.
8. **Cylinder block**

- Checking cylinder bores. See **Cylinder bores, checking**
- Piston and cylinder dimensions: See **PISTON AND CYLINDER DIMENSIONS IN MM**

9. **Connecting rod bearing cap**
    - Note installed position
10. **Oil spray jet**
    - For piston cooling
11. **25 N.m (18 ft lb)**
    - Install without sealant
12. **Connecting rod bolt**
    - 30 N.m (22 ft lb) plus additional 1/4 turn (90°)
    - Always replace
    - Oil the threads and contact surfaces
    - Use old bolts to measure radial clearance

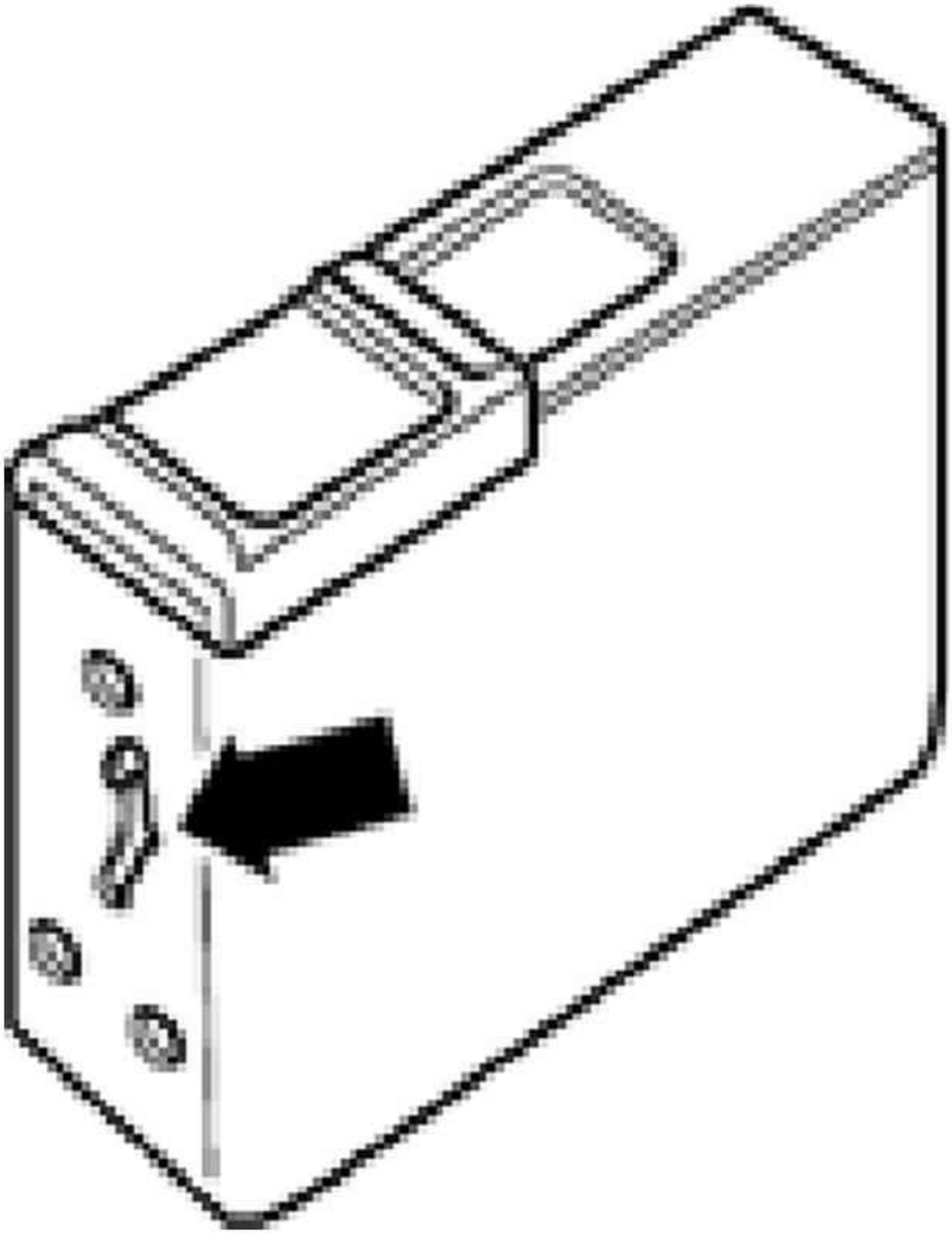

Fig. 58: Disassembling And Assembling Pistons And Connecting Rods
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Piston ring gap, checking

- Squarely insert ring into top of cylinder and push it down to approx. 15 mm from lower edge of cylinder.

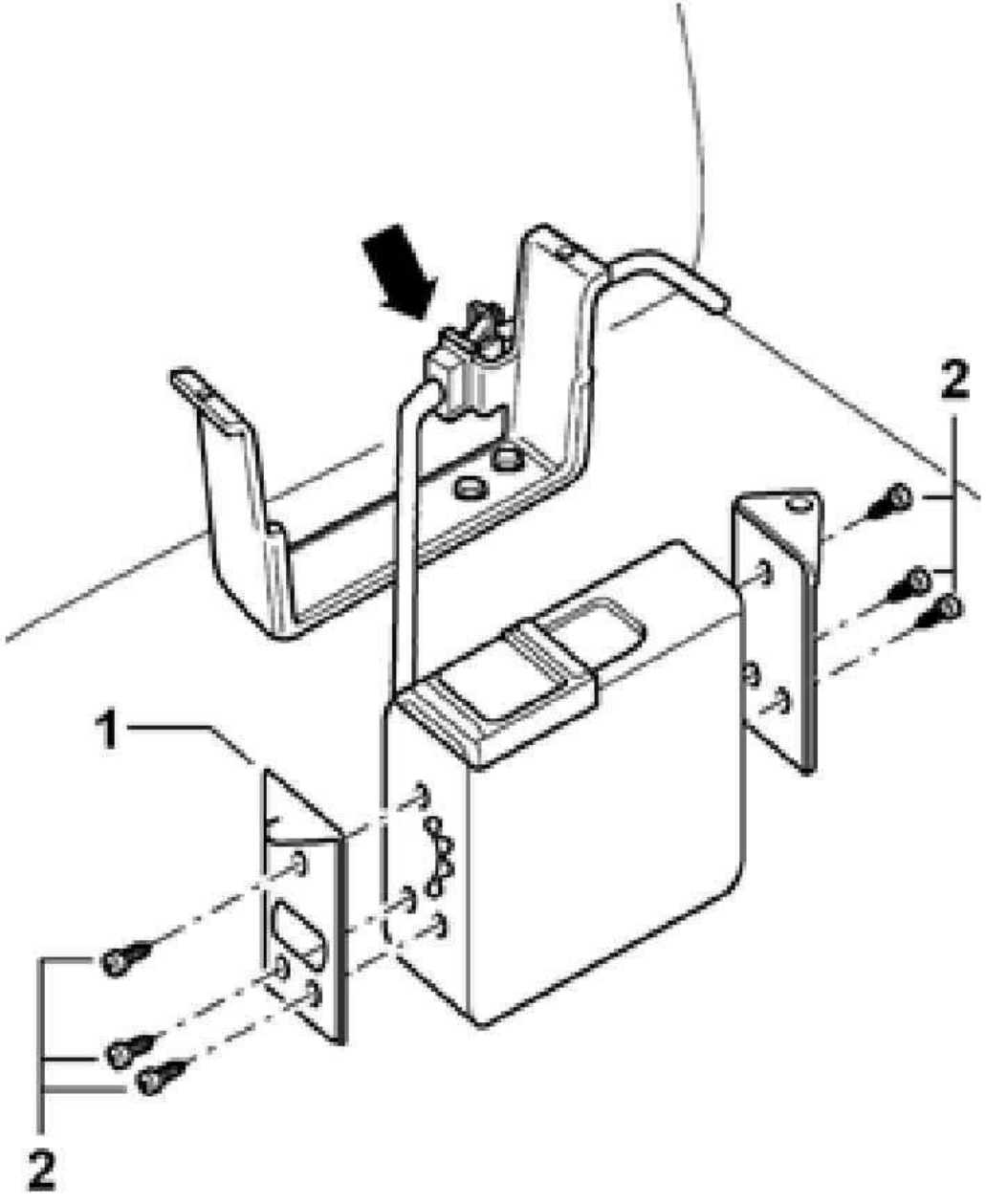

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Fig. 59: Checking Piston Ring Gap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

PISTON RING END GAP DIMENSIONS

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.20 to 0.40	1.0
2nd compression ring	0.20 to 0.40	1.0
Oil scraper ring	0.25 to 0.50	1.0

Ring to groove clearance, checking

Clean groove before checking.

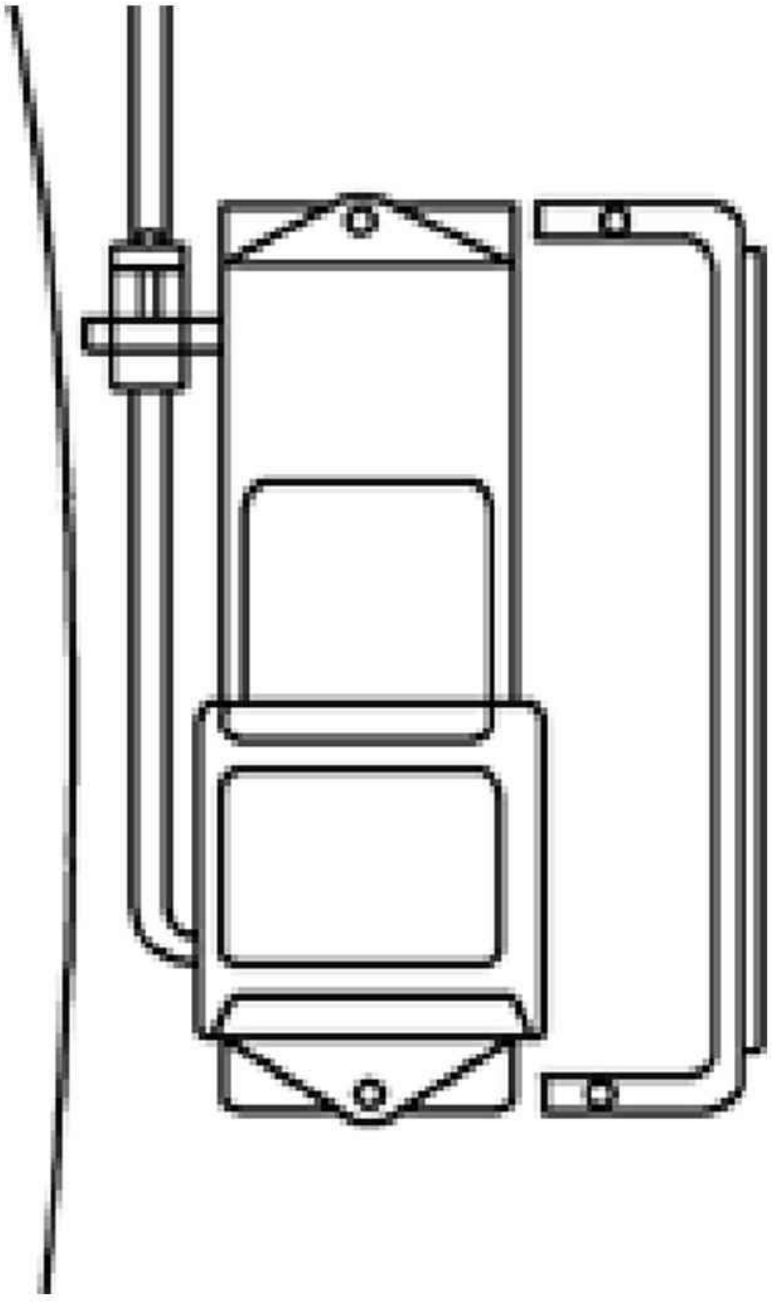

Fig. 60: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

RING TO GROOVE CLEARANCE DIMENSIONS

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.06 to 0.09	0.25
2nd compression ring	0.05 to 0.08	0.25
Oil scraper ring	0.03 to 0.06	0.15

Cylinder bores, checking

Special tools and equipment

- Internal dial gauge 50 to 100 mm
- Take measurements at 3 positions in both lateral -A- and longitudinal -B- directions, as illustrated.
  - Deviation from nominal dimension: 0.10 mm maximum

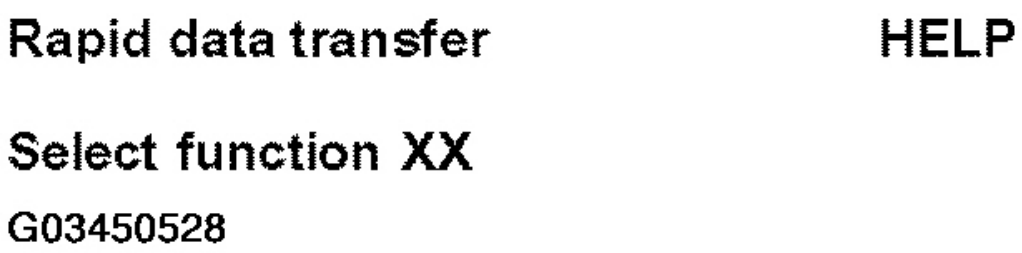

Fig. 61: Checking Cylinder Bores
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Do NOT measure the cylinder bores when the block is mounted on a repair stand using the VW 540 adaptor bracket. Bending stresses resulting from the mass overhang will make incorrect measurements likely.

Piston installation position and piston/cylinder allocation

Piston in cylinders 1 and 2:

Larger intake valve chamber points toward flywheel (arrows)

Piston in cylinders 3 and 4:

Larger intake valve chamber points toward belt pulley side (arrows).

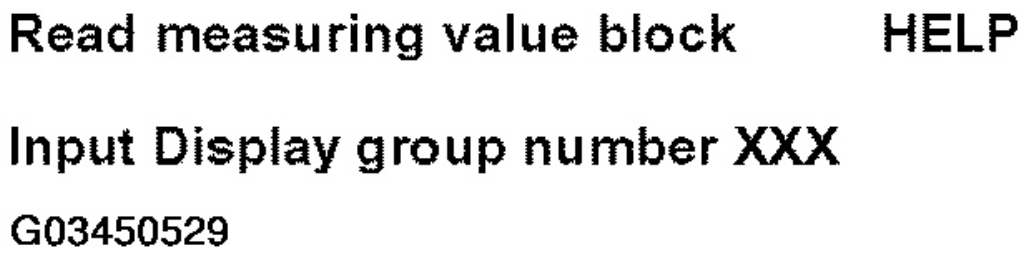

Fig. 62: Identifying Piston Installation Position
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: New piston/cylinder allocations are shown by a colored mark on the piston crown.

- Piston for cylinder 1 and 2: marked 1/2
- Piston for cylinder 3 and 4: marked 3/4

Piston projection at TDC, checking

Special tools and equipment

- VW 382/7

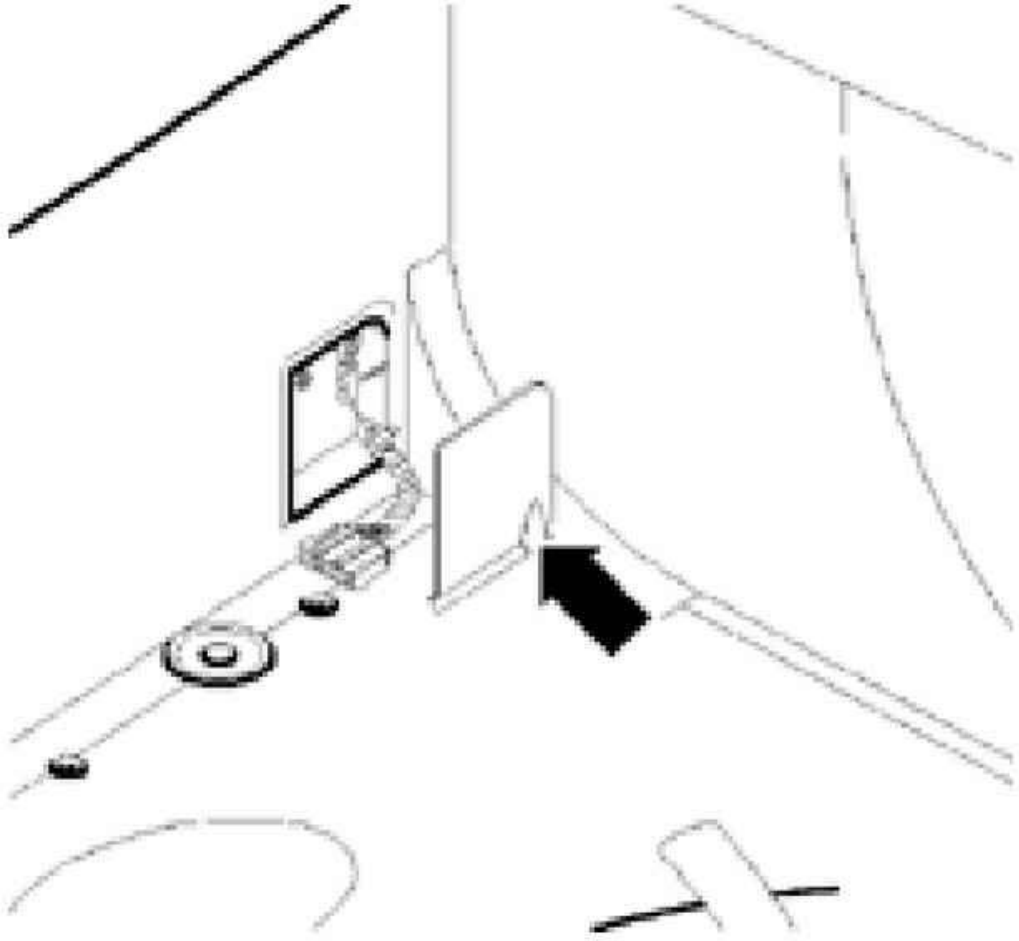

Fig. 63: Identifying VW 382/7
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VW 385/17

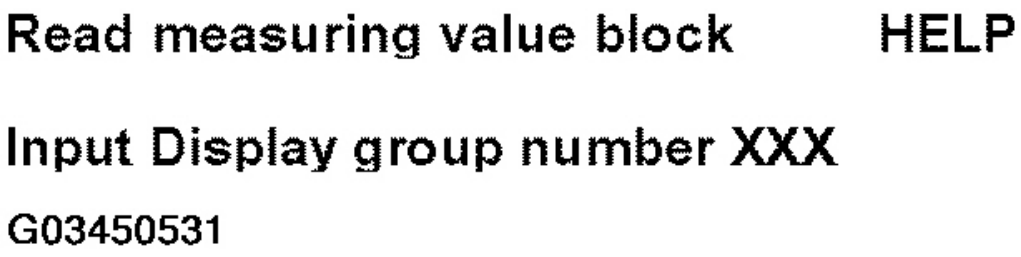

Fig. 64: Identifying VW 385/17
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Test sequence

Piston projection at TDC must be measured when installing new pistons or a short block. Depending upon piston projection, install the corresponding cylinder head gasket using the following table:

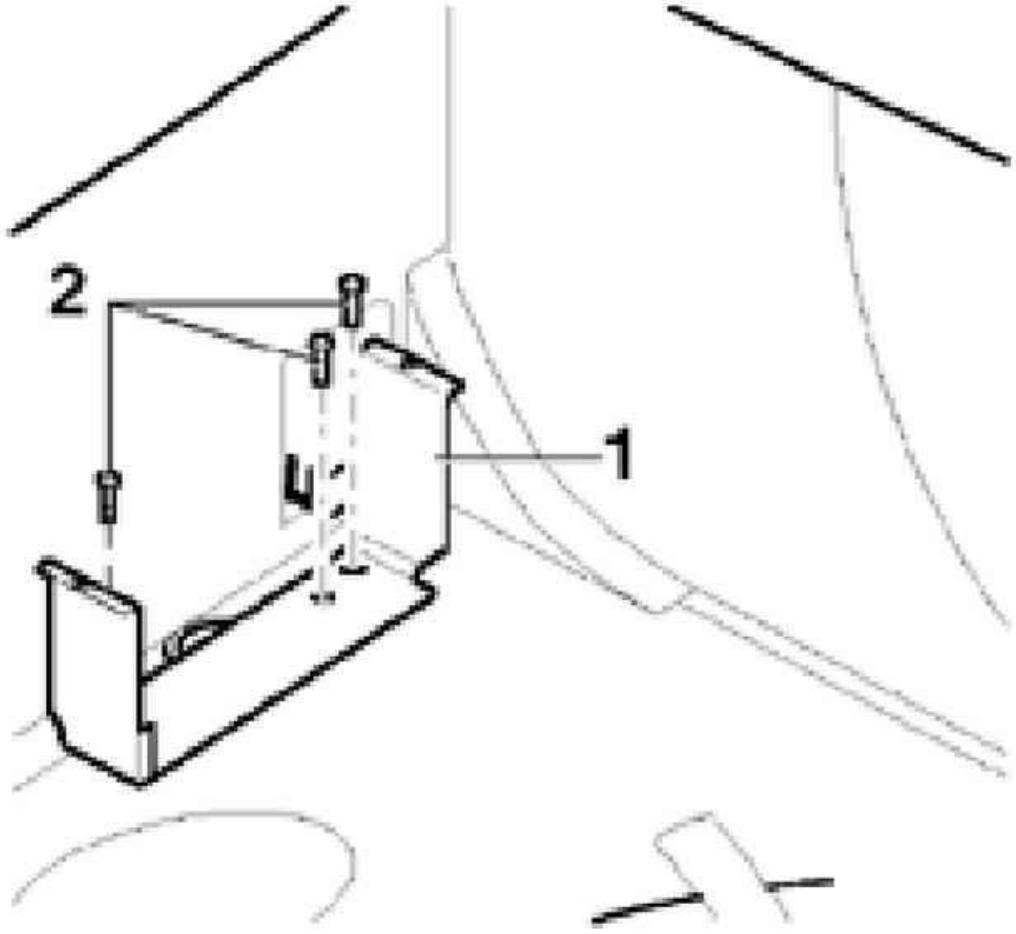

Fig. 65: Measuring Piston Projection At TDC
Courtesy of VOLKSWAGEN OF AMERICA, INC.

PISTON PROJECTION IDENTIFICATION

Piston projection	Identification: holes / notches
0.91 mm to 1.00 mm	1
1.01 mm to 1.10 mm	2
1.11 mm to 1.20 mm	3

Cylinder head gasket, identification

- Part No. = arrow -1-
- Production control code = arrow -2- (can be disregarded)
- Holes = arrow -3-

NOTE: **If different values are obtained from the piston projection measurements, use the largest measurement to select the proper gasket.**

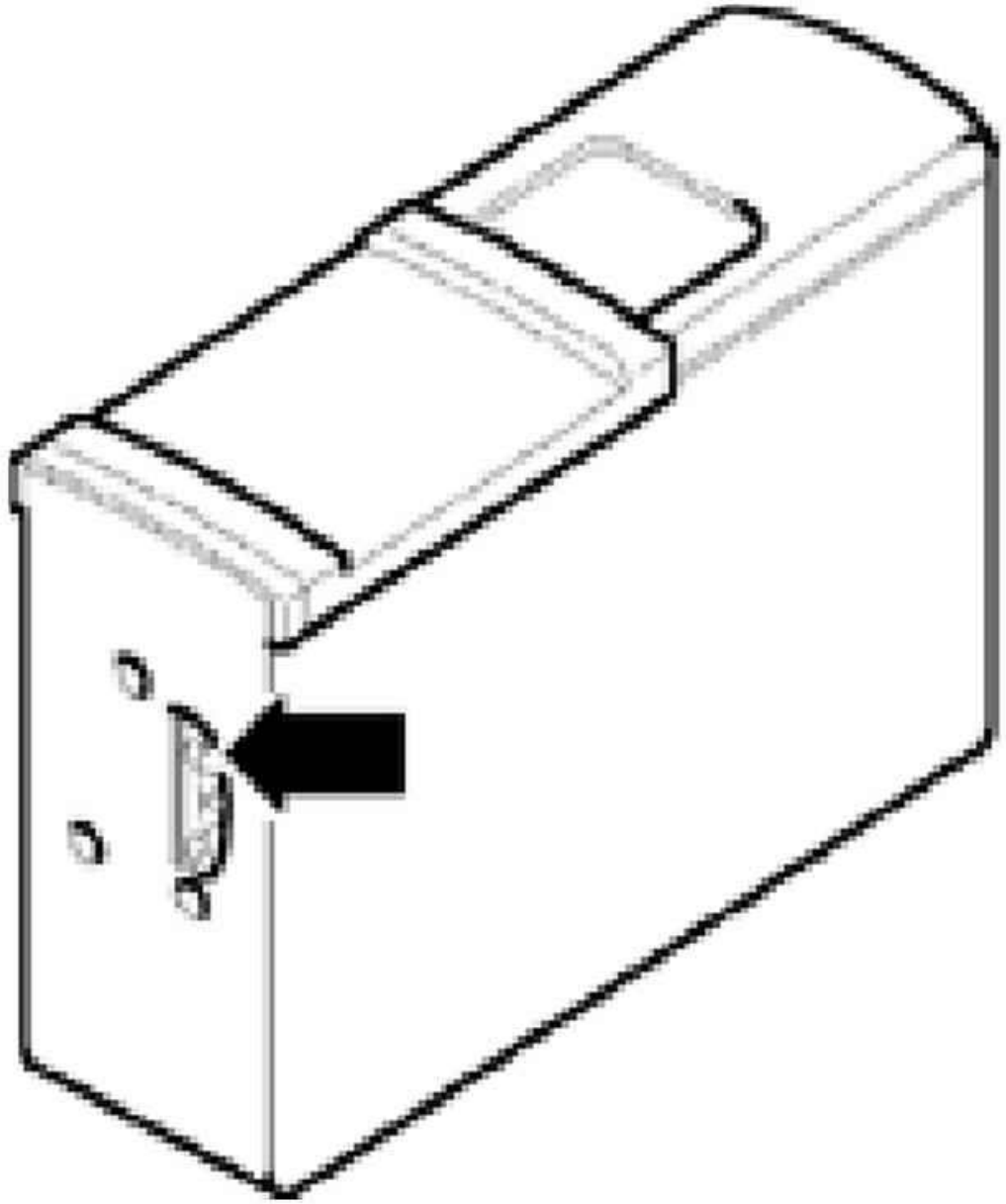

Fig. 66: Identifying Cylinder Head Gasket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Piston and cylinder dimensions in mm

PISTON AND CYLINDER DIMENSIONS

Honing dimension	Piston diameter	Cylinder bore diameter
Basic dimen., mm	79.47	79.51
1st oversize, mm	79.72	79.76
2nd oversize, mm	79.97	80.01

ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD, REMOVING AND INSTALLING

Compression checking **COMPRESSION PRESSURE, CHECKING**

NOTE:

- **When installing an exchange cylinder head (complete with installed camshafts): Oil the contact surfaces between the lifters and the cam lobes before installing the valve cover.**
- **Do NOT remove the plastic packing pieces which protect the open valves until immediately before installing the cylinder head.**
- **If the cylinder head is replaced:**
  - **Replace the entire engine coolant.**

NOTE: The following list refers to items in Fig. 67 .

1. **Toothed belt guard, upper section**
2. **Toothed belt**
   - Mark direction of engine rotation before removing
   - Check for wear
   - Do not kink
   - Removing and installing. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
3. **20 N.m (15 ft lb)**
4. **20 N.m (15 ft lb)**
5. **45 N.m (33 ft lb)**
6. **Camshaft sprocket**
   - Drive off of camshaft taper using hammer and drift through toothed belt guard openings
7. **Tensioning roller (semiautomatic, toothed belt)**
   - Checking: See **SEMI-AUTOMATIC TOOTHED BELT TENSIONING ROLLER, CHECKING**
8. **Idler roller**
9. **Toothed belt guard, rear**
10. **10 N.m (7 ft lb)**

11. **Lifting eye**
12. **Cylinder head bolt**
    - Replace
    - Note sequence when loosening and tightening. See **CYLINDER HEAD, REMOVING AND INSTALLING**
13. **Oil deflector**
14. **Valve cover**
    - With vulcanized seal
    - Replace complete if damaged or leaking

CAUTION: The valve cover seal is an integral part of the valve cover. Replace the valve cover only if it is damaged or leaking.

15. **Seal**
    - Replace if damaged
16. **Cap**
    - Replace seal if damaged
17. **Breather pipe**
18. **Retaining clip**
19. **Pressure regulating valve**
    - For Positive Crankcase Ventilation valve
20. **Gasket**
    - Replace if damaged
21. **5 N.m (44 in. lb)**
22. **Fuel injector lines**
    - 25 N.m (18 ft lb)
    - Remove using 3035 offset tubing wrench
    - Always remove fuel line cluster as an assembly
    - Do not bend, kink or alter shape
23. **Exhauster**
    - For brake booster
24. **Gasket**
    - Always replace
25. **Fuel injector**
    - Removing and installing:

See **FUEL INJECTORS, REMOVING AND INSTALLING**

26. **Glow plug**
    - 15 N.m (11 ft lb)
    - Checking:

    See **GLOW PLUGS -Q6-, CHECKING**

27. **Cylinder head gasket**
    - Replace
    - Note marking. See **Cylinder head gasket, identification**
    - If replaced; also replace entire engine coolant

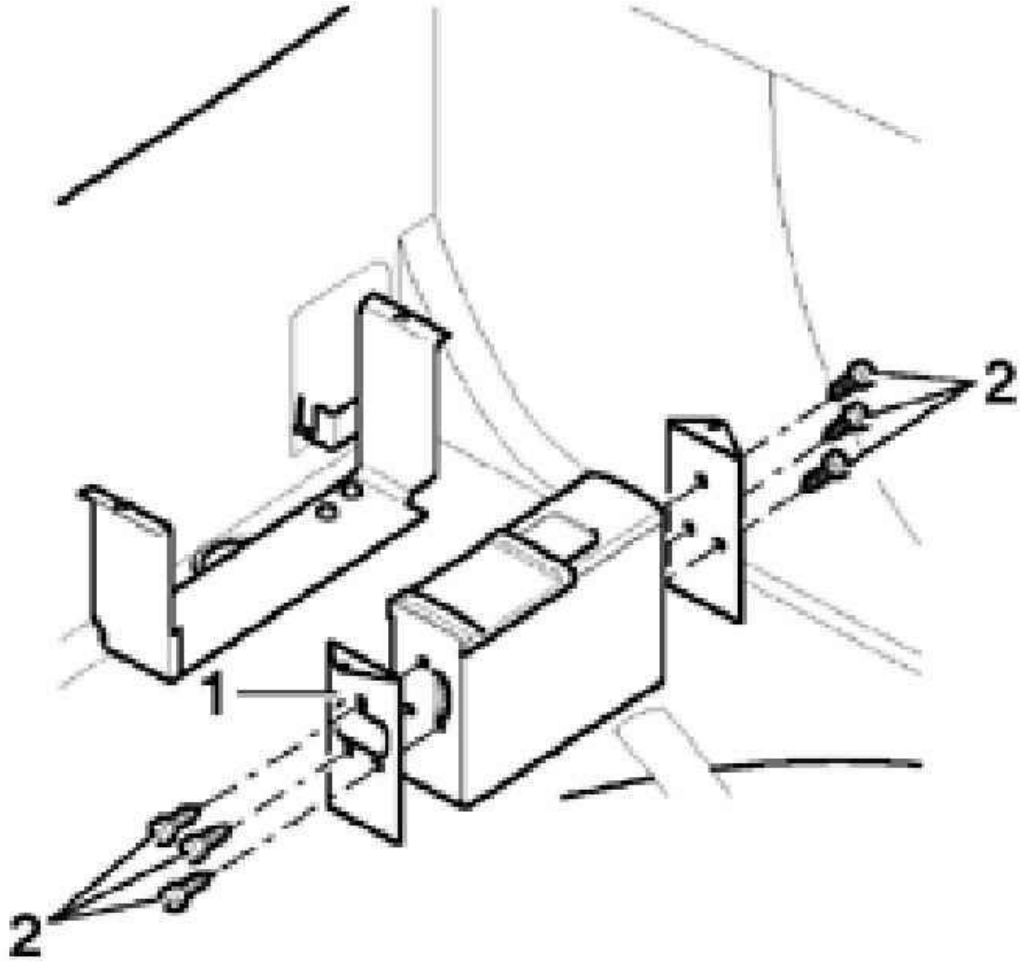

Fig. 67: Exploded View Of Cylinder Head Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Cylinder head distortion, checking

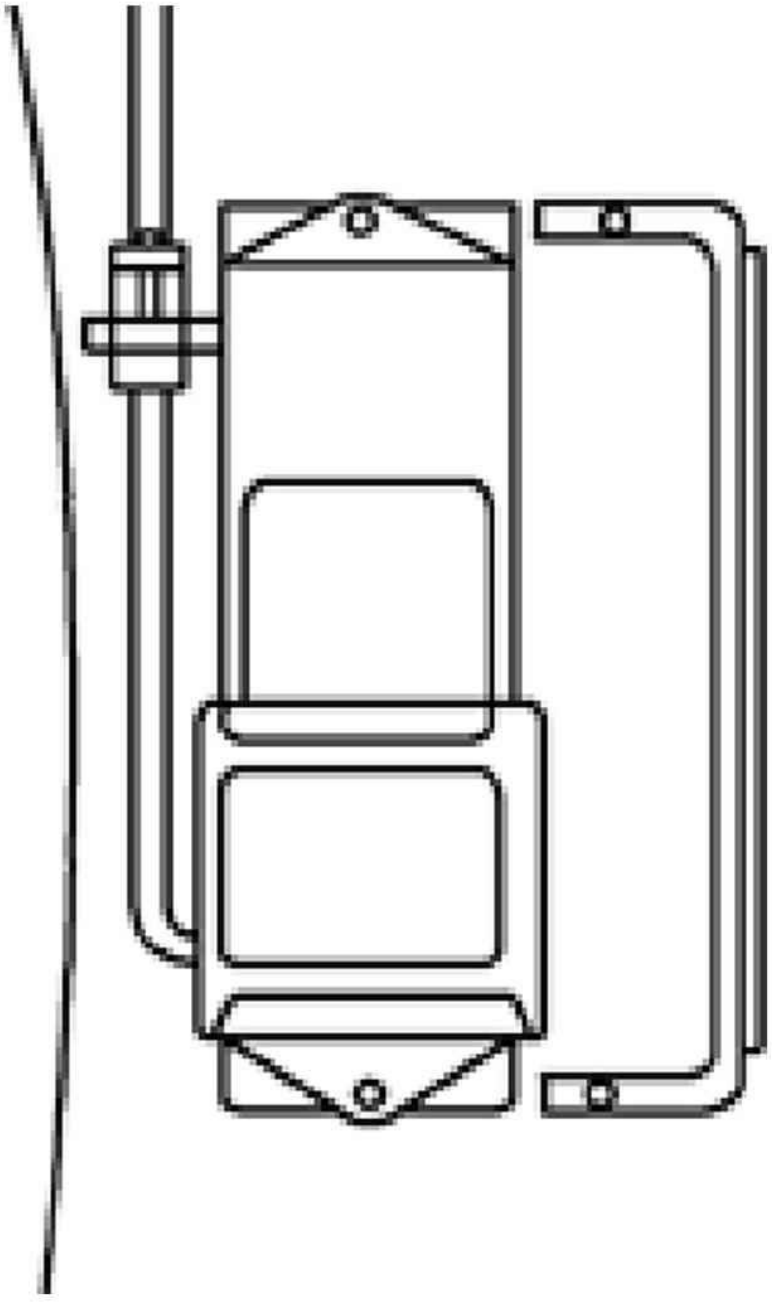

Fig. 68: Checking Cylinder Head Distortion
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Max. permissible distortion: 0.1 mm

NOTE: Reworking Diesel cylinder heads is not permissible.

Cylinder head gasket, identification

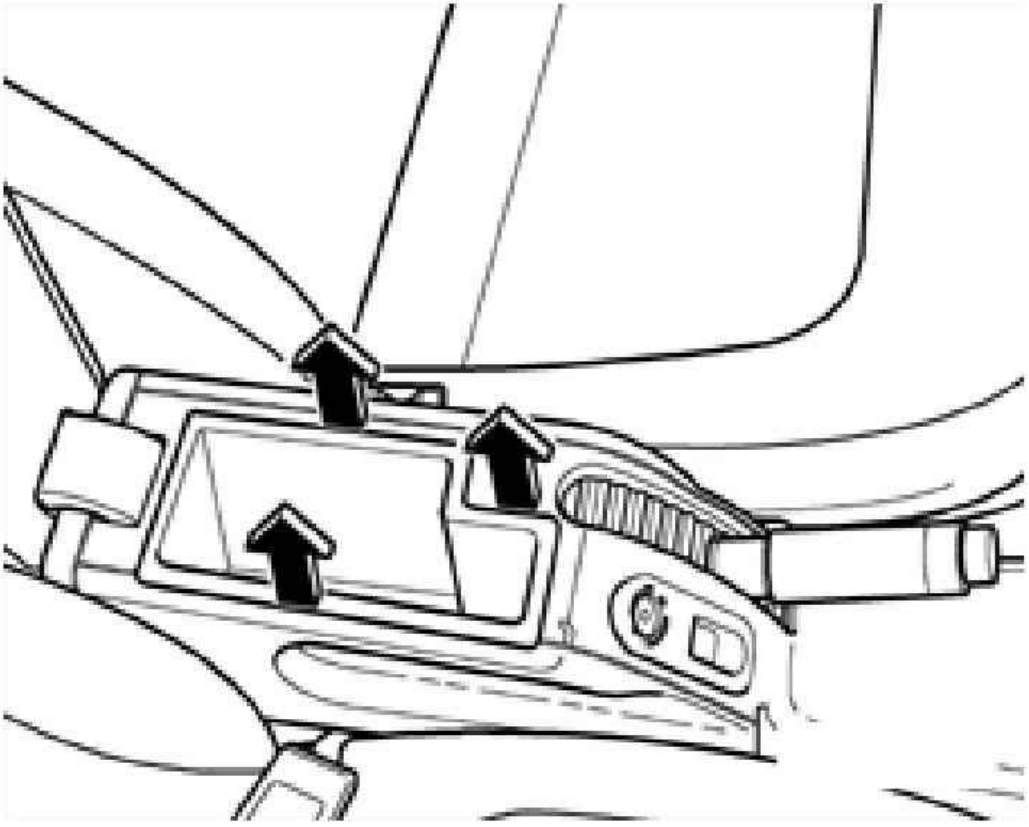

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Fig. 69: Identifying Cylinder Head Gasket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Part No. = arrow -1-
- Production control code = arrow -2- (ignore)
- Holes = arrow -3-

NOTE: Different thicknesses of cylinder head gasket are installed depending on the piston projection dimension. When replacing the cylinder head gasket, install a new gasket with the same identification.

Cylinder head, removing and installing

Special tools and equipment

- 10-222A Engine support bridge
- 10-222 A/8 Adaptor
- 3035 Injector line wrench
- 3070 Guide pins & handle-1112 mm
- T 10014 Engine support
- VAG 1306 Drip tray for VAG 1202A

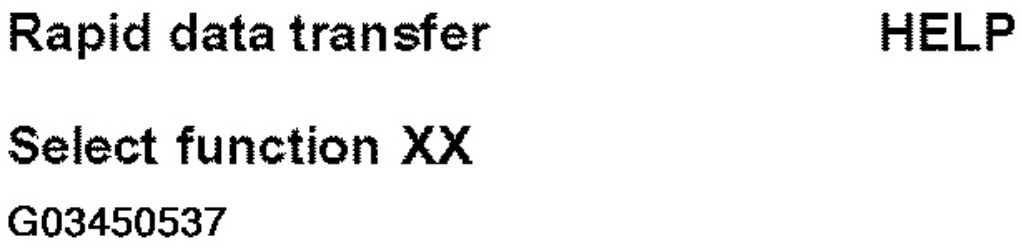


Fig. 70: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG 1331 Torque wrench: 5 to 50 N.m (3.7 to 37 ft lb)
- VAG 1332 Torque wrench: 40 to 200 N.m(30to148ftlb)
- VAG 1921 Hose clip pliers

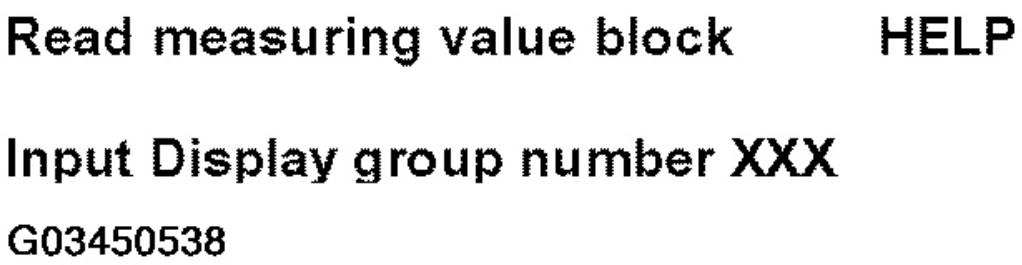


Fig. 71: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirements

- Engine must NOT be more than warm to the touch.
- Pistons must NOT be positioned at TDC.

Removing

CAUTION: Obtain radio anti-theft code from customer before disconnecting battery ground strap.

- With ignition switched OFF, disconnect battery Ground strap.
- Remove engine cover.
- Remove Air Cleaner.
- Remove connecting pipe between Charge Air cooler and intake manifold/EGR Vacuum Regulator Solenoid valve.
- Remove sound dampening tray:

  See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Drain engine coolant. See **COOLING SYSTEM, DRAINING AND FILLING**
- Disconnect fuel supply and return lines at fuel filter.

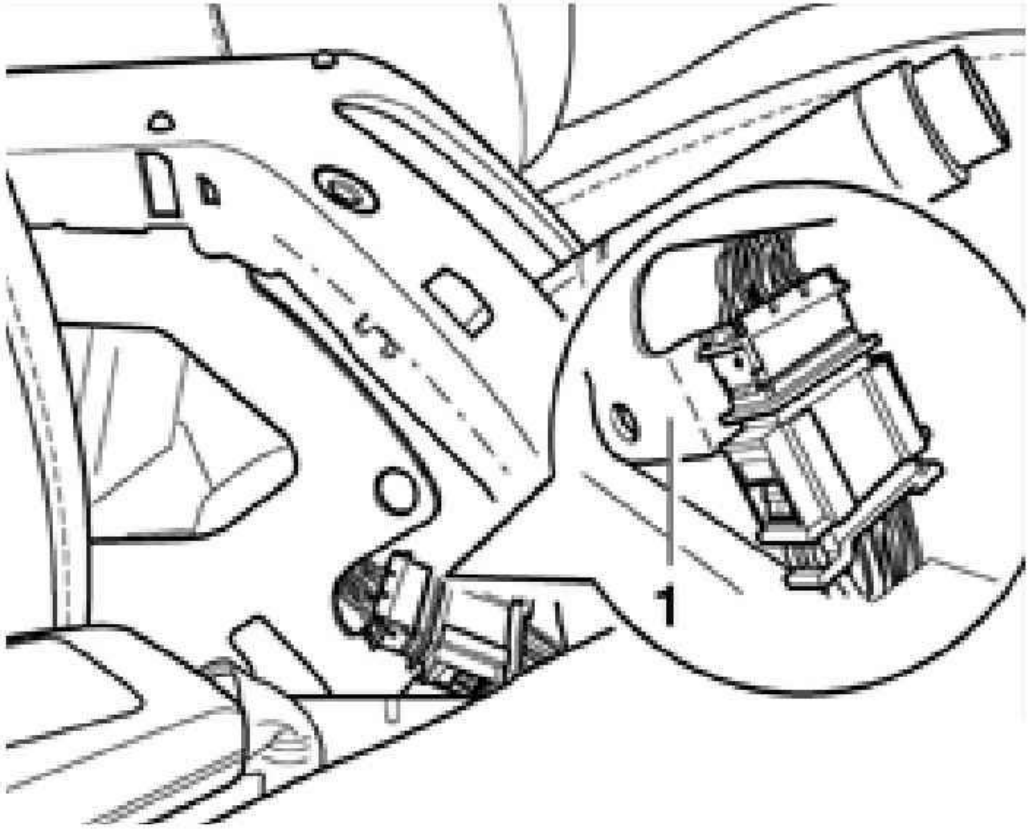


Fig. 72: Disconnecting Fuel Supply And Return Lines
Courtesy of VOLKSWAGEN OF AMERICA, INC.

WARNING: Fire hazard! Do NOT have anything in the area that can ignite Diesel fuel!

- Seal lines so fuel system is not contaminated by dirt etc.
- Remove front exhaust pipe. See **FRONT EXHAUST PIPE AND CATALYST WITH ATTACHMENTS**
- Remove ribbed belt. See **RIBBED BELT TENSIONER, REMOVING AND INSTALLING**
- Unscrew wiper arms.
  - M8 hex nuts = 20 N.m (15 ft lb)
- Remove plenum chamber cover.

See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Disconnect fuel supply and return lines at fuel filter.
- Remove fuel filter with bracket
- Disconnect all coolant, vacuum and breather hoses from engine.
- Disconnect all wiring connections from transmission, Generator and starter and move to one side.
- Loosely unscrew coolant reservoir and place to side.
- Remove toothed belt guard upper section.
- Remove valve cover.
- Remove brake booster vacuum pump.
- Unscrew turbocharger oil return line to cylinder block.
- Unscrew oil supply line at turbocharger
- Remove injection lines.

NOTE: Always remove injection lines as a set. Use 3035 offset tubing wrench to loosen/tighten the injection lines.

- Remove return line from injector jets/injection pump.
- Remove glowplug harness connector.
- Install engine support bracket 10-222A with 10-222 A/1 legs.

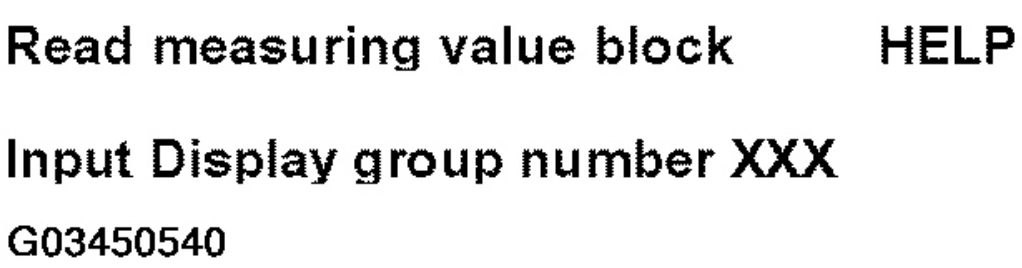


Fig. 73: Installing Engine Support Bracket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosely unscrew subassembly (engine side) from upper engine bracket (arrows).
- Remove engine mount and engine bracket.
- Lift engine again slightly using spindle -B-.

NOTE: Both lifting eyes are located on the cylinder head, therefore an additional

bracket must be attached to the block to support the engine.

- Attach T 10014 bracket to cylinder block using threaded hole in water pump area (as illustrated).

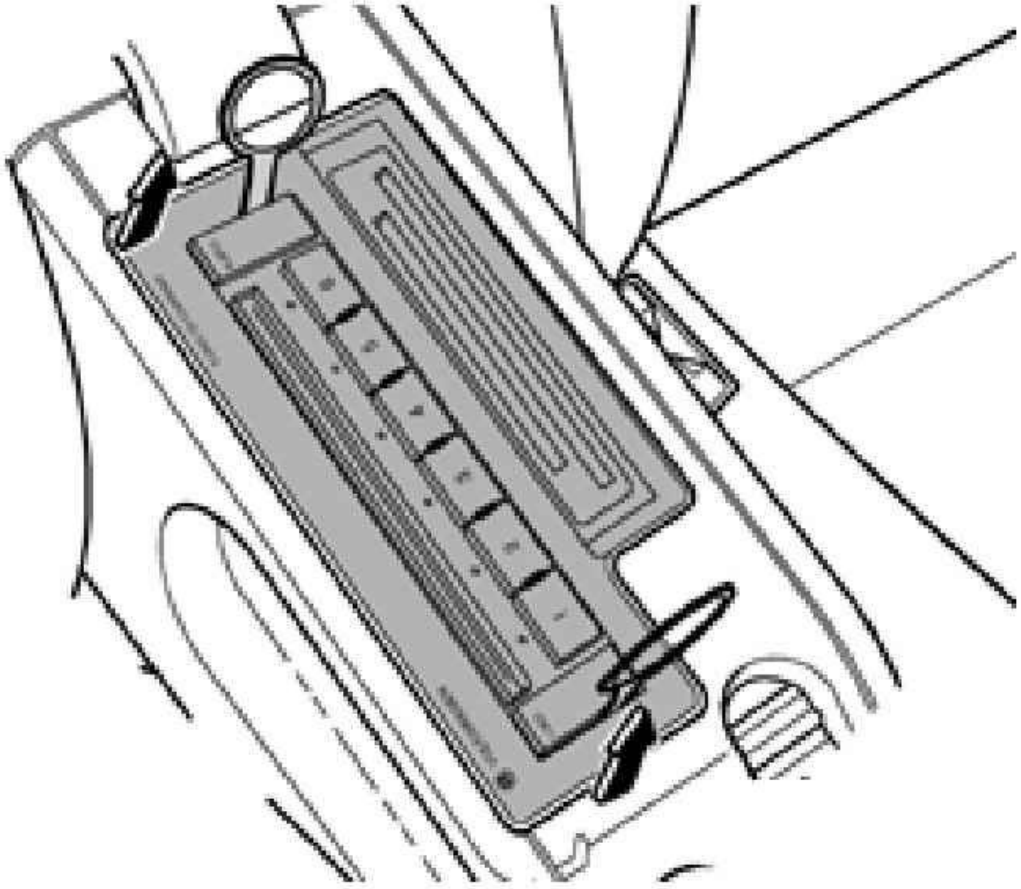
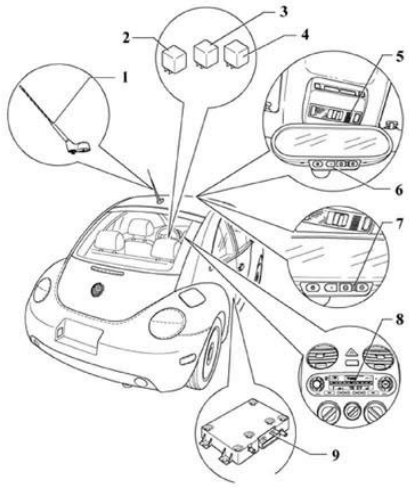


Fig. 74: Attaching T 10014 Bracket To Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lift engine slightly using second spindle -A- until spindle -B- is relieved.
- Remove spindle -B-.
- Position engine at TDC with camshaft sprocket loosened and toothed belt removed from camshaft sprocket. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
- Remove tension roller and camshaft sprocket.

- Unscrew upper bolt of belt guard, rear.
- Loosen socket head bolts in sequence given, then remove bolts completely.



1 - Antenna -R11-, Antenna Amplifier - R24- and Antenna for Navigation System (GPS) -R50-

- On roof, rear
- Removing and installing

2 - Dual Horn Auxiliary Relay -J733-

- On 13-position auxiliary relay panel, above relay panel.

3 - Auxiliary Emergency Flasher Relay -J517-

- On 13-position auxiliary relay panel, above relay panel.

4 - Warning Lamp Auxiliary Relay - J734-

- On 13-position auxiliary relay panel, above relay panel.

5 - Telephone Microphone -R38-

- Integrated with front interior light module.
- Removing and installing

6 - Telematic Control Head -E264-

- Integrated with rear view mirror.
- OnStar® buttons, description
- Includes telematics indicator lamp -7-.
- Removing and installing

7 - Telematics Indicator Lamp -K186-

- In Telematic Control Head.
- LED indicates telematic system operational status. Description
- Telematic system, troubleshooting using telematics indicator lamp

8 - Radio -R-

- In center console.

9 - Telematic Control Module -J499-

- Installed behind right rear side panel trim under rear speaker.
- Removing and installing
- Control module multi-pin connector terminal assignments

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Fig. 75: Loosening Head Bolts In Sequence

Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully lift off cylinder head.

Installing

NOTE:

- **Always replace cylinder head bolts.**
- **Make sure that there isn't any oil or coolant in the cylinder head bolt hollows (in the cylinder head).**
- **Only remove the new cylinder head gasket from its packing immediately before installing.**
- **When repairing, carefully remove any gasket remains from the cylinder head and cylinder block. Ensure that no long grooves or scratches are created. When using abrasive paper do not use a grade coarser than 100 (e.g. 80).**
- **Carefully remove any emery or abrasive remains.**
- **Handle the new gasket with extreme care. Damaging will lead to leaks.**

- Turn crankshaft to TDC mark before installing cylinder head.
- Turn crankshaft against engine direction of rotation until all pistons are approximately equally spaced below TDC.
- To centralize: screw guide pins from 3070/9 into outer threaded holes on intake side.

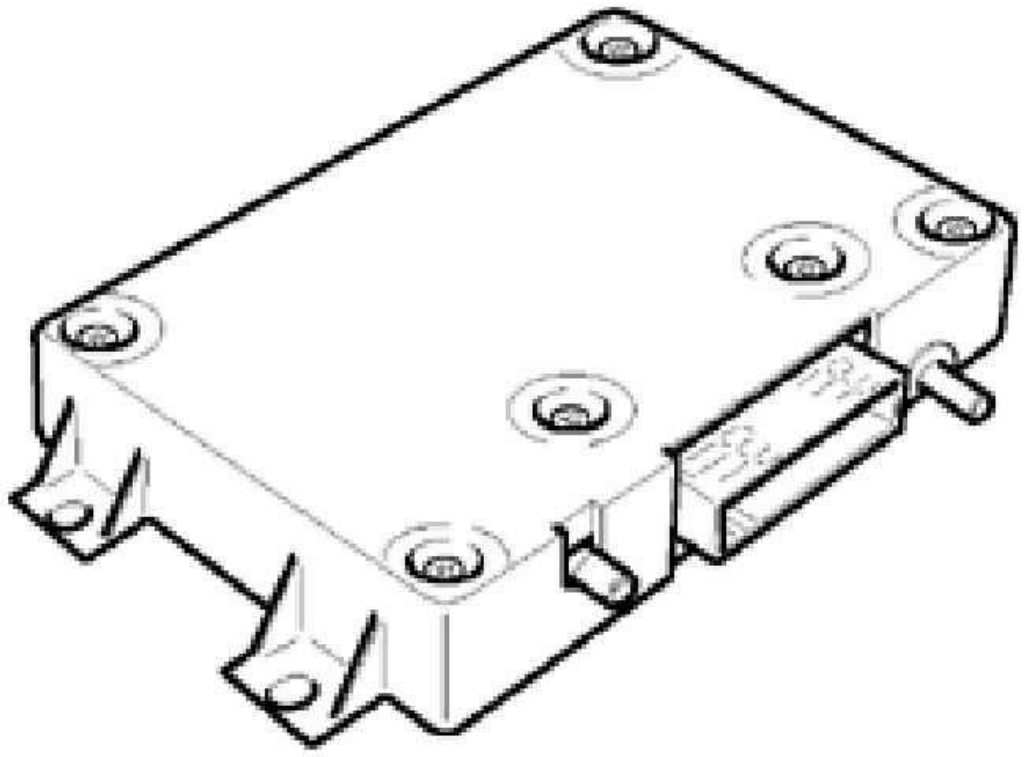

Fig. 76: Identifying Screw Guide Pins
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install new cylinder head gasket.
  - Lettering (Part No.) must be readable.
- Install cylinder head, screw in 8 remaining head bolts and tighten by hand.
- Remove guide pins with removal tool from 3070 by turning removal tool counter-clockwise until pins are free
- Install remaining cylinder head bolts and tighten hand-tight.
- Tighten cylinder head in following four stage sequence:
- Tighten initially using torque wrench:

Stage I = 40 N.m (30 ft lb)

Stage II = 60 N.m (44 ft lb)

- Turn further with a normal wrench:

  Stage III 1/4 turn (90°)

  Stage IV 1/4 turn (90°)

Assembly is basically a reverse of the disassembly sequence.

- Installing toothed belt and timing adjustment. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
- Coolant, filling. See **COOLING SYSTEM, DRAINING AND FILLING**

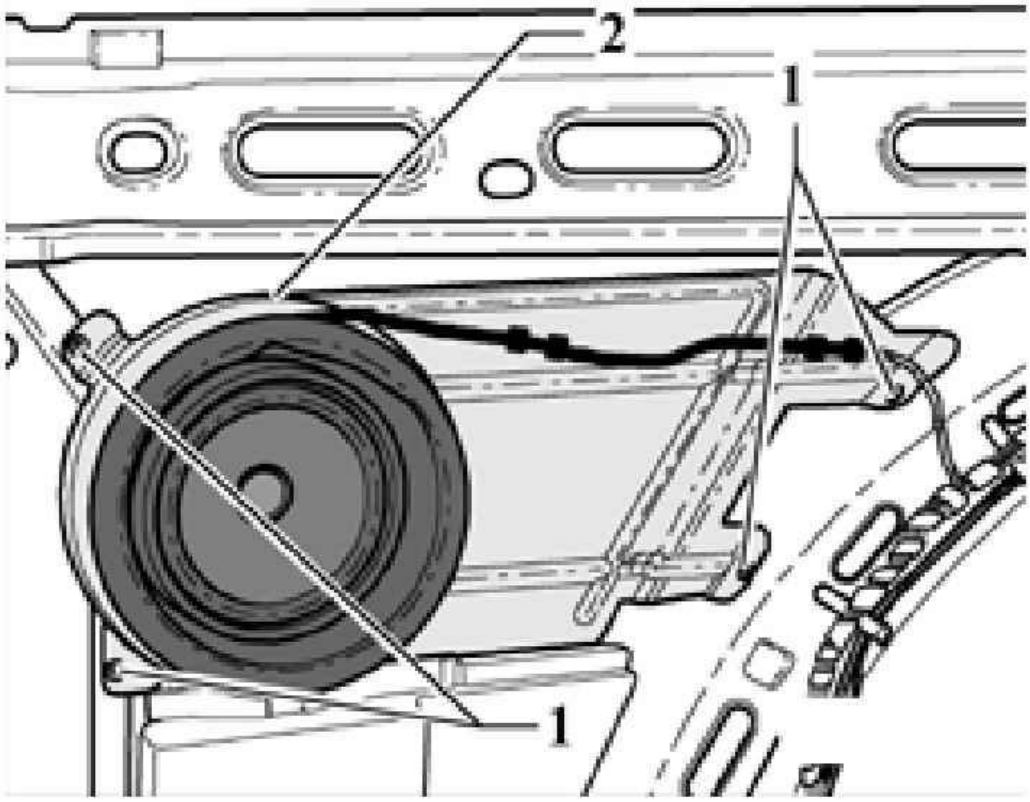

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Fig. 77: Tightening Cylinder Head Bolts In Sequence
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Compression pressure, checking

Special tools and equipment

- 3220 Hinged socket
- VAG 1331 Torque wrench: 5 to 50 N.m (3.7 to 37 ft lb)
- VAG 1381/12 Adaptor
- VAG 1763 Compression tester

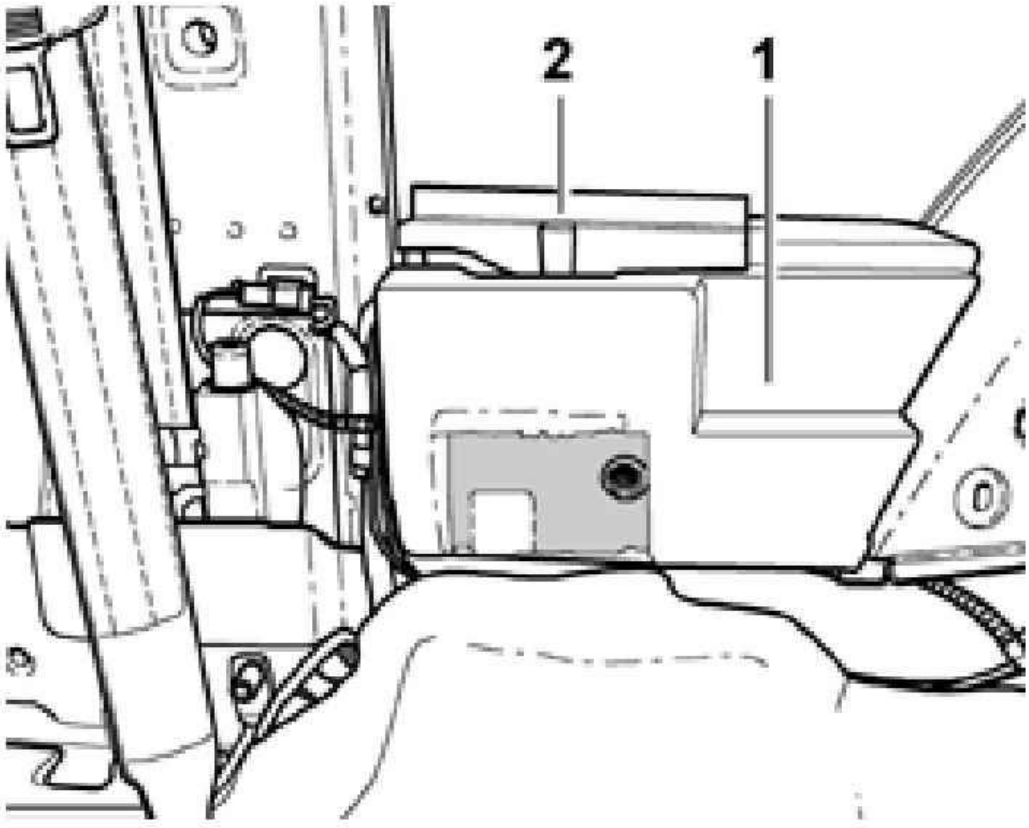


Fig. 78: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirement

- Engine oil temperature must be 30°C minimum.

Test sequence

- Disconnect fuel cut-off valve on Diesel injection pump.
- Disconnect Quantity adjuster harness connector on Diesel injection pump.
- Remove all glow plugs using 3220 flexible wrench.
- Screw in VAG 1381/12 adaptor in place of glow plugs.

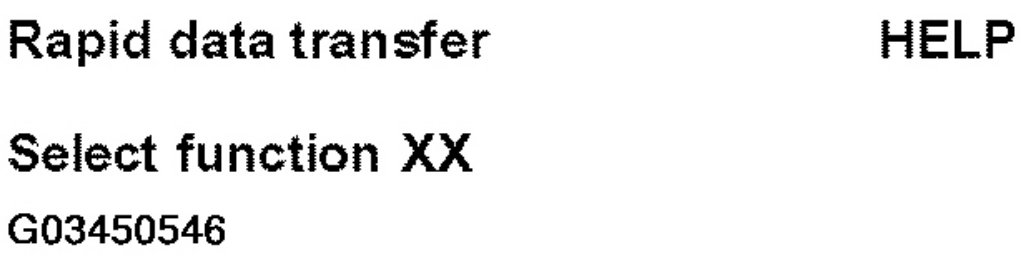


Fig. 79: Checking Compression With Compression Tester
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check compression using VAG 1763 compression tester.
- Operate starter until tester display shows no further increase.

Compression pressure:

- New: 25 to 31 bar
- Wear limit: 19 bar

Permissible difference between all cylinders:

- 5 bar

- Install glow plugs using 3220 flexible wrench
  - Tightening torque: 15 N.m (11 ft lb)
- Check Diagnostic Trouble Code (DTC) memory:

  See **DTC MEMORY, CHECKING**

NOTE: **Trouble codes will be stored because the Diesel injection pump harness connector has been disconnected. Check and erase DTC memory.**

VALVE TRAIN, SERVICING

NOTE: Cylinder heads with cracks between the valve seats may be used without reducing engine life, provided the cracks are small and not more than 0.5 mm wide.

NOTE: The following list refers to items in Fig. 80 .

1. **Bearing cap**
   - Installation position. See **Camshaft bearing caps, installed position**
   - Installation sequence. See **CAMSHAFT, REMOVING AND INSTALLING**
2. **20 N.m (15 ft lb)**
3. **Camshaft**
   - Axial clearance, checking. See **Camshaft axial clearance, checking**
   - Removing and installing: See **CAMSHAFT, REMOVING AND INSTALLING**
   - Checking radial clearance with plastigage Wear limit: 0.11 mm
   - Run-out: max. 0.01 mm
   - Identification and valve timing. See **Identification**
4. **Hydraulic lifter**
   - Do not interchange
   - Checking. See **HYDRAULIC LIFTERS, CHECKING**
   - Store with cam contact surface facing downward
   - Before installing, check camshaft axial clearance. See **Camshaft axial clearance, checking**
   - Oil contact surfaces
5. **Keepers**
6. **Upper valve spring plate**
7. **Valve spring**
   - Removing and installing: With cylinder head removed Use 2037 With cylinder head installed. See **VALVE STEM SEALS, REPLACING**
8. **Valve stem seal**
   - Replacing. See **VALVE STEM SEALS, REPLACING**
9. **Valve guide**
   - Checking. See **VALVE GUIDES, CHECKING**
   - Replacing. See **VALVE GUIDES, REPLACING**
   - Service version with collar
10. **Oil seal**
    - To remove and install, remove bearing cap
    - Toothed belt, removing and installing. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING**
11. **Cylinder head**

- See note. See **VALVE TRAIN, SERVICING**
- Valve seats, reworking. See **VALVE SEATS, REWORKING**

12. **Valves**
    - Valve dimensions. See **Valve dimensions**

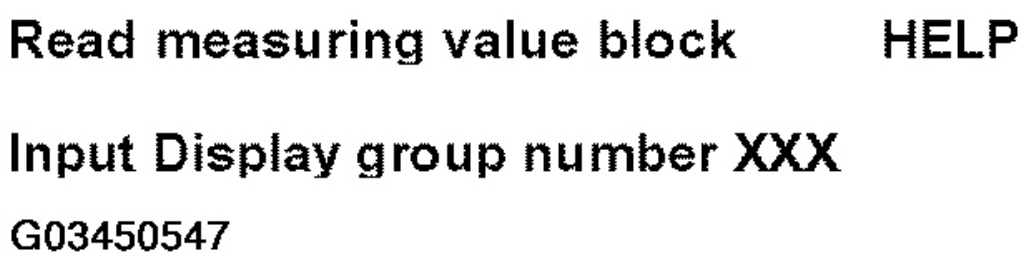


Fig. 80: Identifying Valve Train
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Camshaft axial clearance, checking

Fig. 81: Checking Camshaft Axial Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools and equipment

- VW 387 Universal dial gauge bracket
- Dial gauge

NOTE: Check with hydraulic lifters removed and with first and last bearing caps

fitted.

- Wear limit: max. 0.15 mm

Camshaft bearing caps, installed position

Fig. 82: Identifying Camshaft Bearing Caps Position
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Note offset. Before installing camshaft trial install the bearing caps and determine the correct position.

Valve dimensions

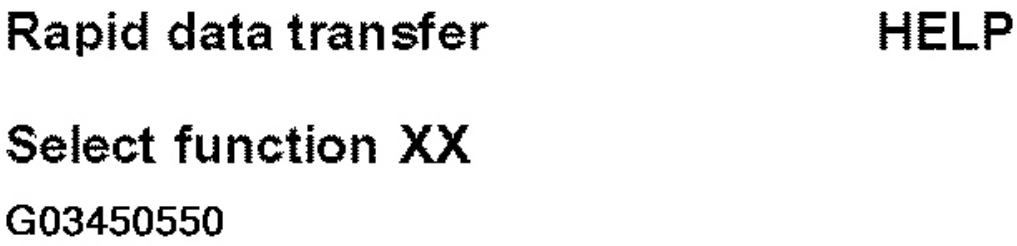


Fig. 83: Identifying Valve Dimensions
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Valves must not be reworked. Only lapping-in is permitted.

VALVE DIMENSION CHART

Dimension	Intake valve	Exhaust valve
diameter a mm	35.95	31.45
diameter b mm	6.963	6.943
c mm	96.85	96.85
"ALPHA ANGLE" °	45	45

Camshaft identification, valve timing

Identification

- Cam base diameter: a = 38 mm diameter
- Camshaft is identified by stamped numbers and letters between intake and exhaust cams:

CAMSHAFT IDENTIFICATION

Engine code	ALH
Cylinder 1 (arrow -A-)	38K
Cylinder 2 (arrow -B-)	DE

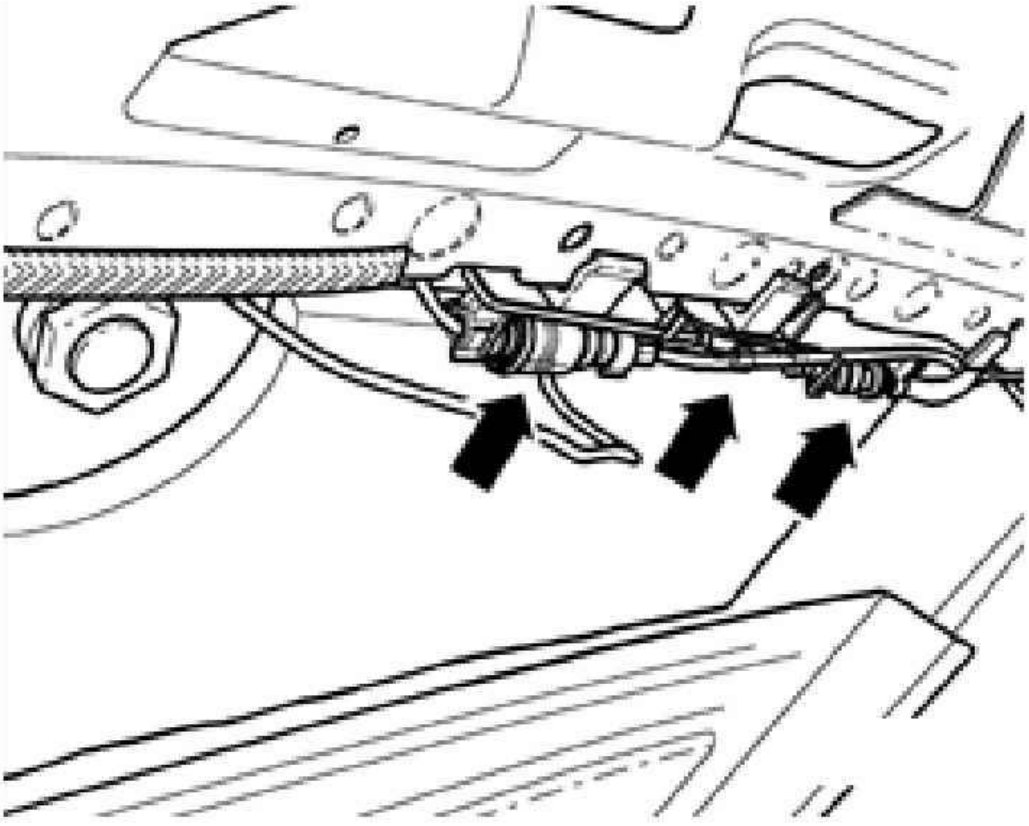


Fig. 84: Identifying Camshaft
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Valve timing at 1 mm valve lift

VALVE TIMING CHART

Engine code	ALH
Intake opens after TDC	16 °
Intake closes after BDC	25 °
Exhaust opens before BDC	28 °
Exhaust closes before TDC	19 °

Valve seats, reworking

Special tools and equipment

- Depth gauge
- Valve seat refacing tool

NOTE:

- **When repairing engines with leaking valves, it is not always sufficient to merely reface or replace valve seats and valves. It is also necessary to check the valve guides for wear. This is particularly important on high mileage engines.**
- **The valve seats should only be reworked enough to produce a perfect seating pattern. The maximum permissible reworking dimension must be calculated before reworking starts. If this dimension is exceeded, the hydraulic lifter function can no longer be guaranteed and the cylinder head should be replaced.**

Maximum permissible reworking dimension, calculating:

- Insert valve and press firmly against seat.

NOTE: **If the valve will be replaced as part of a repair, use the new valve for the calculation.**

- Measure distance -a- between end of valve stem and upper edge of cylinder head.
- Calculate maximum permissible reworking dimension from measured distance -a- and minimum dimension.

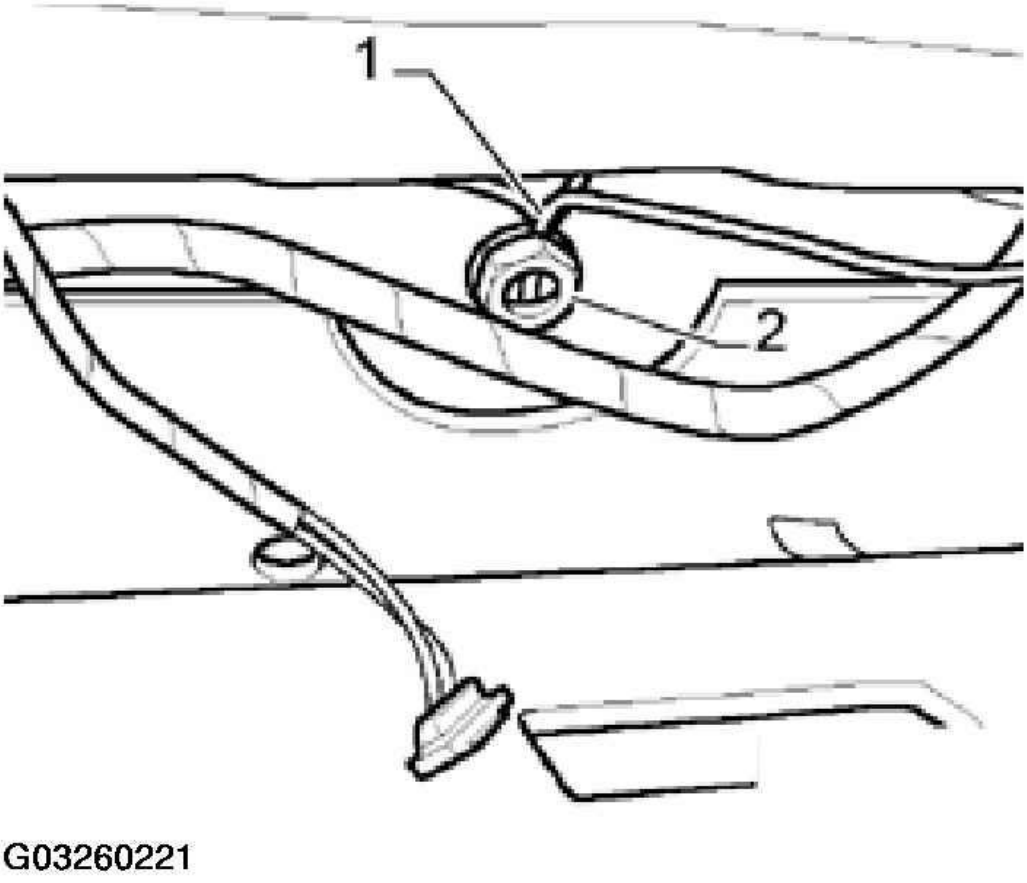


Fig. 85: Measuring Distance Between End Of Valve Stem And Upper Edge Of Cylinder Head
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Minimum dimension:

Intake valve 35.8 mm

Exhaust valve 36.1 mm

Measured distance minus minimum dimension = Maximum permissible reworking dimension.

Example:

MAXIMUM PERMISSIBLE REWORKING DIMENSION (EXAMPLE)

Dimension	Measurement
Measured distance	36.5 mm

Minus Minimum dimension	35.8 mm
= Max. perm. rework dimension	0.7 mm

Intake valve seat, reworking

a = 35.7 mm diameter

b =1.6 mm

45° = Valve seat angle

NOTE: The 30° lower valve seat chamfer is necessary to make sure that the intake channel flow characteristics are maintained.

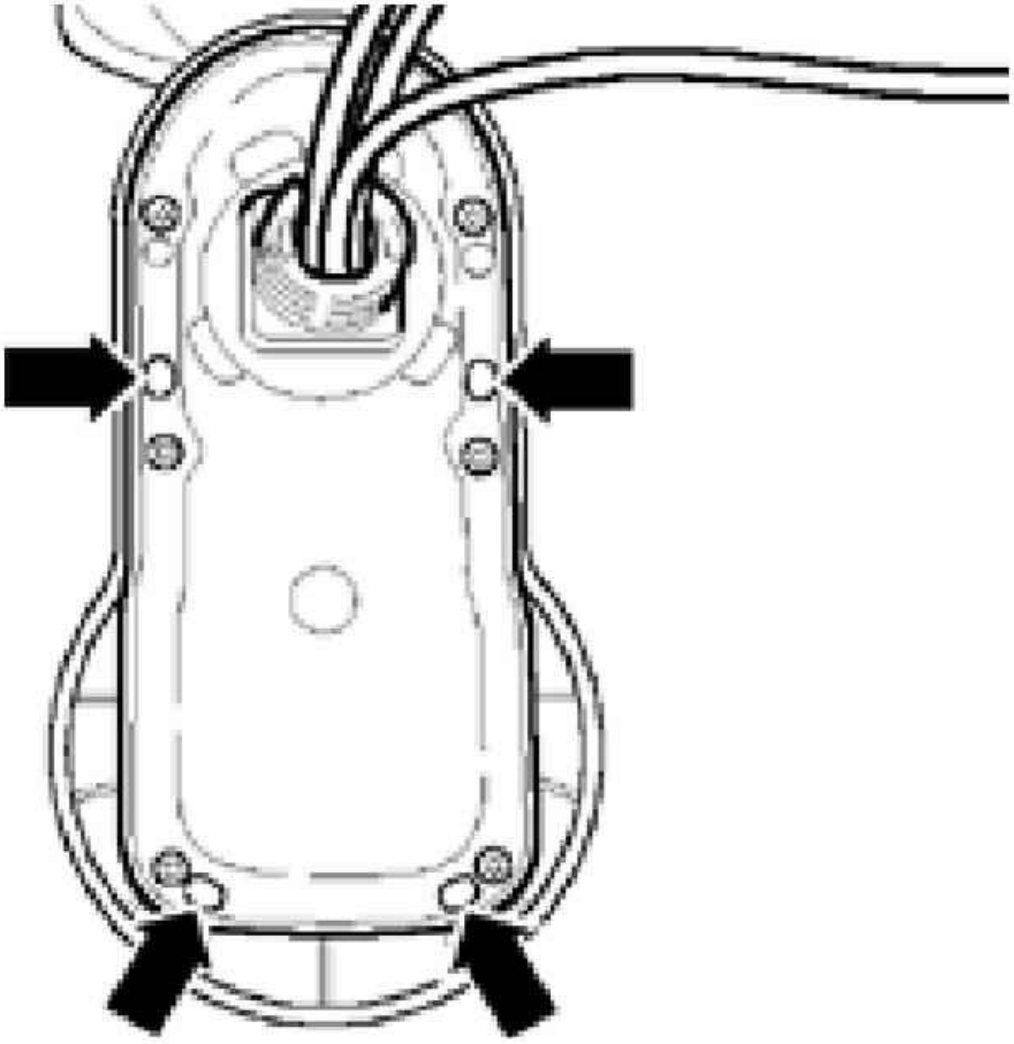


Fig. 86: Identifying Intake Valve Seat Angle
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Exhaust valve seat, reworking

a = 31.4 mm diameter

b =2.7 mm

45°= Valve seat angle

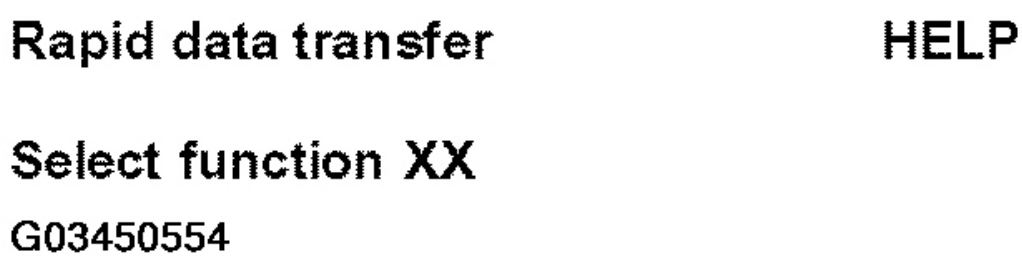
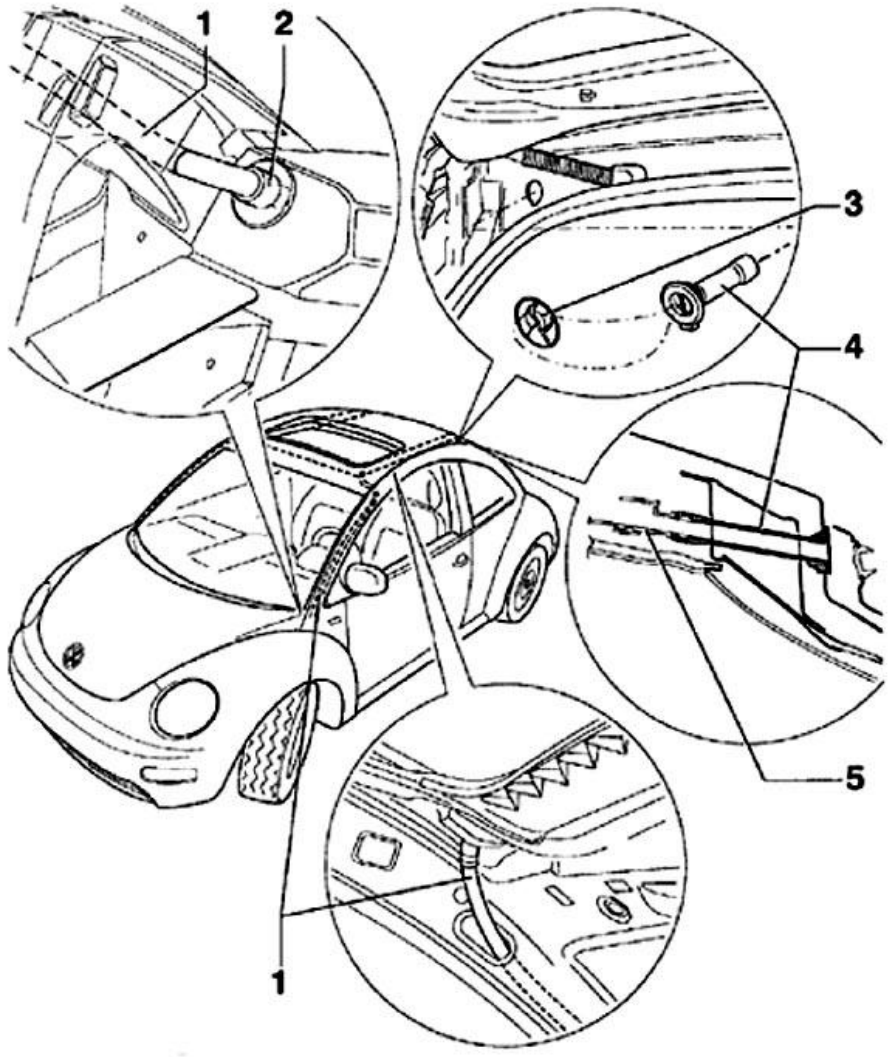


Fig. 87: Identifying Exhaust Valve Seat Angle
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Valve guides, checking

Special tools and equipment

- VW 387 Universal dial gauge bracket
- Dial gauge



1 - Front water drain hoses.

2 - Front water drain valve.

3 - Cover.

4 - Water drain hose with valve.

5 - Carrier unit.

Fig. 88: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Test sequence

- Insert new valve into guide until end of valve stem is flush with end of guide. Due to slight differences in stem dimensions, make sure that an intake valve is used in intake guide and an exhaust valve in exhaust guide.
  - Rock: 1.3 mm maximum

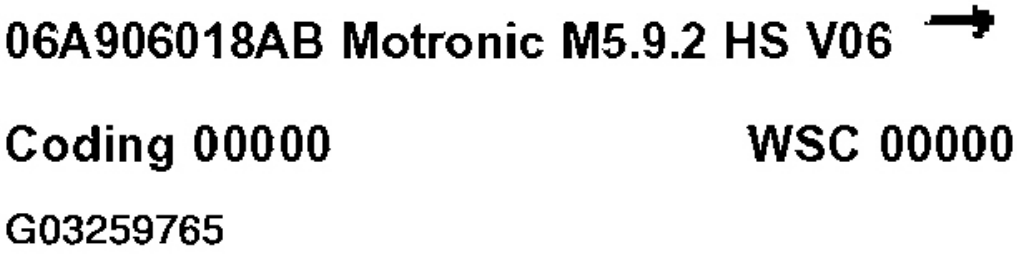


Fig. 89: Measuring Valve Rock
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Valve guides, replacing

Special tools and equipment

- 3121 Drift

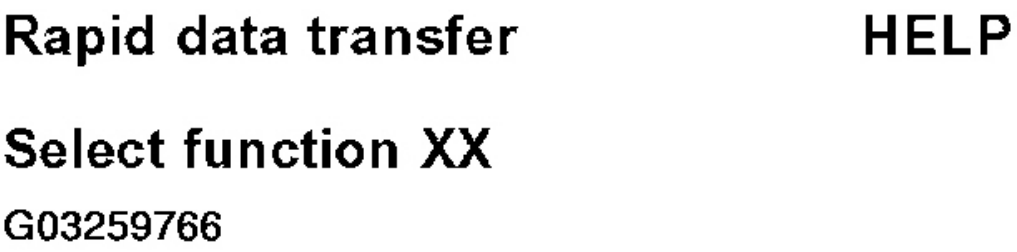


Fig. 90: Identifying 3121 Drift
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- 3120 Reamer and cutting fluid

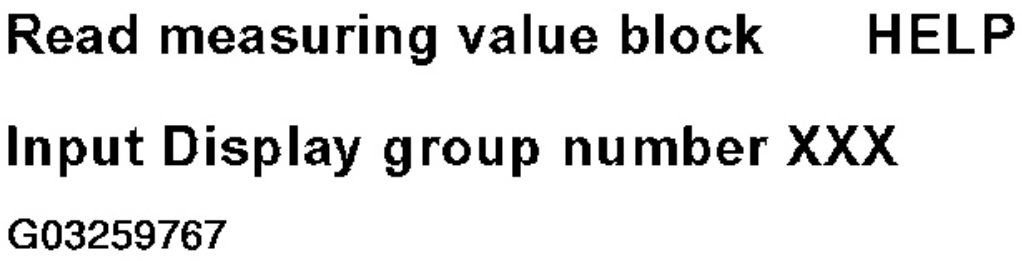


Fig. 91: Identifying 3120 Reamer And Cutting Fluid
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Clean and check cylinder head.

NOTE: Do not replace the valve guides in cylinder heads where the valve seats can no longer be reworked, or cylinder heads which have already been machined to the minimum dimension.

- Press out worn valve guides using 3121 from camshaft side (valve guides with shoulder service version from combustion chamber side).

Installing

- Press new guides in up to shoulder (moistened with oil) from camshaft side in cold cylinder head using 3121 drift.

NOTE: When the valve guide shoulder makes contact, do NOT allow the pressure to exceed 2000 psi or shoulder could break off.

- Ream out guides with 3120 hand reamer and plenty of cutting fluid.
- Rework valve seats. See **VALVE SEATS, REWORKING**

Valve stem seals, replacing

Special tools and equipment

- 2036 Adjustable rod
- 3047A Slide hammer
- 3129 Seal driver

- VW 541/1A Valve spring lever
- VW 541/5 Thrust piece

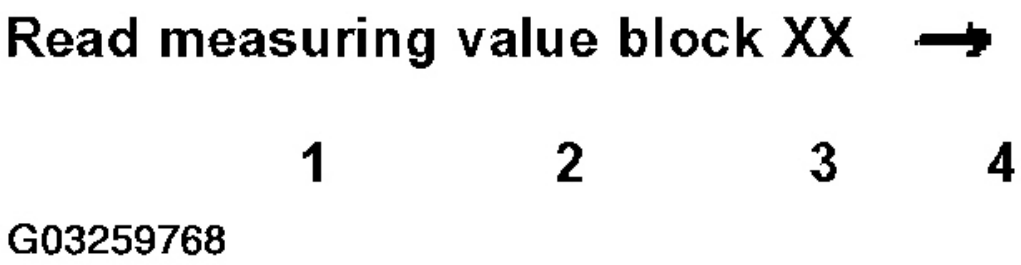


Fig. 92: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

(with cylinder head installed)

- Remove camshaft. See **CAMSHAFT, REMOVING AND INSTALLING**
- Remove hydraulic lifters and set them with contact surfaces facing down. Make sure lifters are not interchanged in process.
- Set piston of respective cylinder to Top Dead Center.
- Install 2036 adjustable rod and adjust mountings to height of studs.

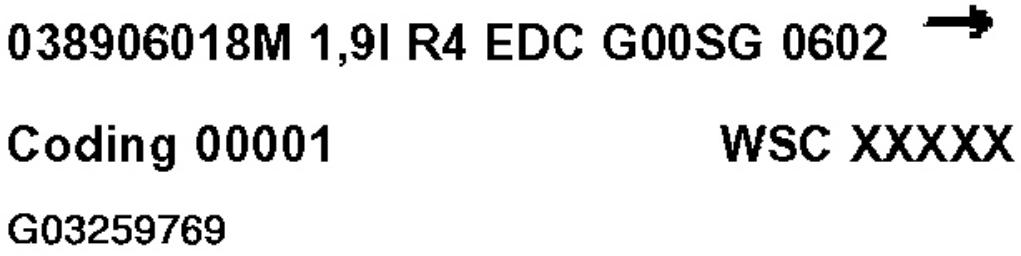


Fig. 93: Installing 2036 Adjustable Rod And Adjust Mountings
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove valve springs with VW 541/1A lever and VW 541/5 press piece.

NOTE: The valves are supported by the piston crown.

- Remove valve stem seals using 3047A.

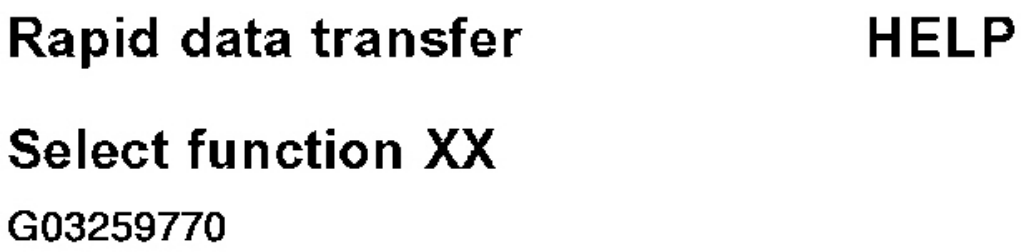


Fig. 94: Removing Valve Stem Seals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

- Place plastic sleeve supplied on appropriate valve stem. This will prevent new valve stem seal from being damaged.
- Insert new valve stem seal in 3129 installation tool.
- Oil valve stem seal sealing lip and press carefully onto valve guide.

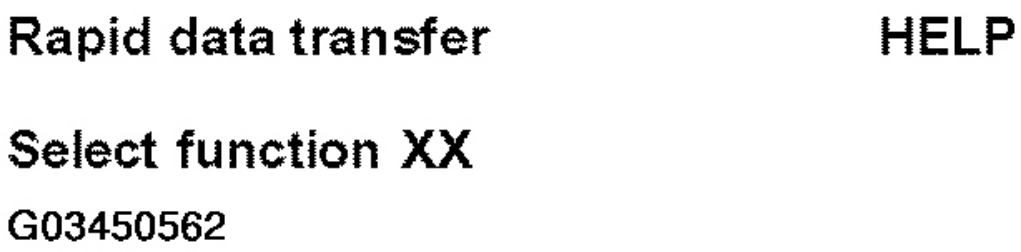


Fig. 95: Installing Plastic Sleeve On Valve Stem
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Camshaft, removing and installing

Special tools and equipment

- 3359 Rig pin
- 3418 Adjustment guide
- V159 Nut wrench
- VAG 1331 Torque wrench: 5 to 50 N.m (3.7 to 37 ft lb)

Fig. 96: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove connecting pipe between charge air cooler and intake hose. See **CHARGE AIR COOLER COMPONENTS, REMOVING AND INSTALLING**
- Remove toothed belt guard, upper section.
- Remove valve cover.
- Remove brake booster vacuum pump.

Vehicles with manual transmission:

- Turn crankshaft to cyl. 1 TDC.

Fig. 97: Identifying Mark (Vehicles With Manual Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with automatic transmission:

- Turn crankshaft to cyl. 1 TDC.

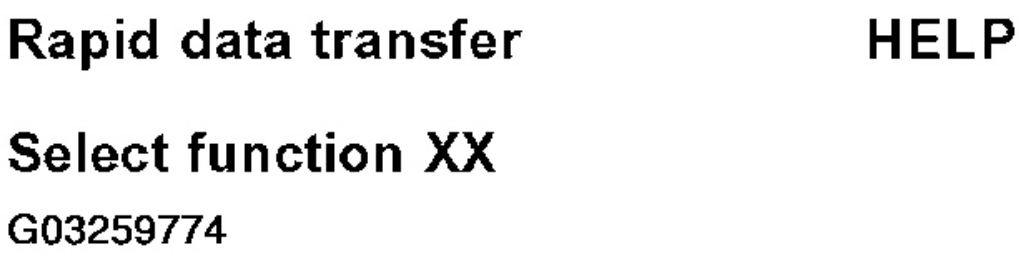


Fig. 98: Identifying Mark (Vehicles With Automatic Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lock camshaft with setting bar.

Rapid data transfer Q

11 - Login procedure

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Fig. 99: Installing Setting Bar On Camshaft
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Release tensioning roller and take toothed belt off camshaft sprocket.
- Loosen camshaft sprocket mounting bolt 1/2 turn.
- Release camshaft sprocket from camshaft taper by tapping with a hammer (using a drift through rear toothed belt guard opening).
- Take off camshaft sprocket.
- First remove bearing caps 5, 1 and 3. Then loosen bearing caps 2 and 4 alternately and diagonally.

Installing

NOTE:

- **When installing the camshaft, No. 1 cylinder cams must point upward.**
- **When installing the bearing cap, note offset before installing camshaft, install bearing caps and determine installed position.**

Login procedure

Input Code Number XXXXX

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Fig. 100: Identifying Bearing Caps Position
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Oil camshaft contact surfaces.
- Install camshaft.
- Tighten bearing caps: 2 and 4 alternately and diagonally
  - 20 N.m (15 ft lb)
- Install bearing caps: 5, 1 and 3.
  - 20 N.m (15 ft lb)
- Position bearing cap 5 by gently tapping on end of camshaft.
- Install camshaft sprocket.
- Install toothed belt and tension. See **TOOTHED BELTS, REMOVING, INSTALLING, TENSIONING** .

Assembly is basically a reverse of the disassembly sequence.

NOTE: Do NOT start the engine for approx. 30 minutes after new lifters have been installed. Hydraulic compensation elements must settle (otherwise the valves will strike pistons).

Hydraulic lifters, checking

Special tools and equipment

- Feeler gauge
- Wood or plastic wedge

NOTE:

- **Replace faulty lifter assembly (cannot be adjusted or repaired).**
- **Irregular valve noises are normal when starting the engine.**

Test sequence

- Start engine and run until engine oil temperature is 80° C minimum
- Increase engine speed to 2500 RPM for approx. 2 minutes.

If lifters are still noisy, locate faulty lifter(s) as follows:

- Remove valve cover.
- Rotate crankshaft clockwise, until cam of lifter to be checked is pointing upward.
- Measure play between cam and lifter.

If play is in excess of 0.1 mm

- Replace hydraulic lifter assembly

If play is less than 0.1 mm or no play

- Proceed with check as follows
- Press down on lifter with a wooden or plastic wedge.

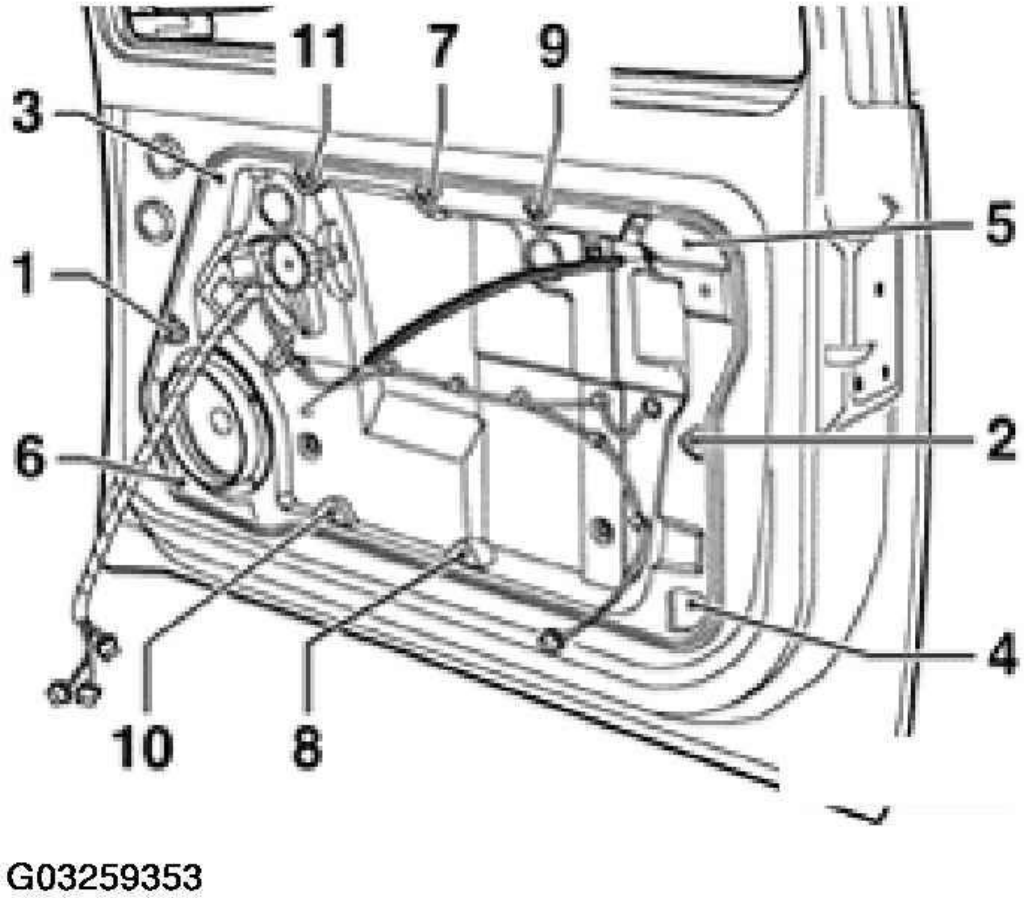


Fig. 101: Identifying Press Down On Lifter With A Wooden Or Plastic Wedge
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If 1 mm or more of travel is felt before the lifter touches the valve:

- Replace hydraulic lifter assembly

NOTE: Do NOT start the engine for approx. 30 minutes after new lifters have been

installed. Hydraulic compensation elements must settle or the valves will strike the pistons.

ENGINE - LUBRICATION

LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING

NOTE:

- **If large quantities of metal particles or other deposits (caused, for example, by partial seizure of the crankshaft or conrod bearings) are found in the engine oil when performing repairs, clean the oil passages thoroughly and replace the oil cooler (mandatory) to prevent future damage.**
- **The oil level must NOT be above the MAX. mark-there is the possible danger of damaging the catalyst!**

Oil pressure, checking. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING** .

Oil capacity up to MY 2000

- With oil filter 4.5 liters (4.75 quarts)

Oil capacity from MY 2001

See maintenance guide with owner's manual.

Engine oil specifications:

The following terms must appear on the oil container singly or in combination with other designations:

- VW 505 00
- ACEA B3 or ACEA B4
- API Service CF4 or API Service CG4

- Engine oils are graded according to their viscosity. The proper grade to be used in your engine depends on existing climatic or seasonal conditions.
- The engine oil which was first put into your engine has a viscosity grade of SAE 5W-40. You can use this oil over all temperature ranges for normal driving. If engine oil viscosity grade SAE 5W-40 is not available, you can also use SAE 5W-30.

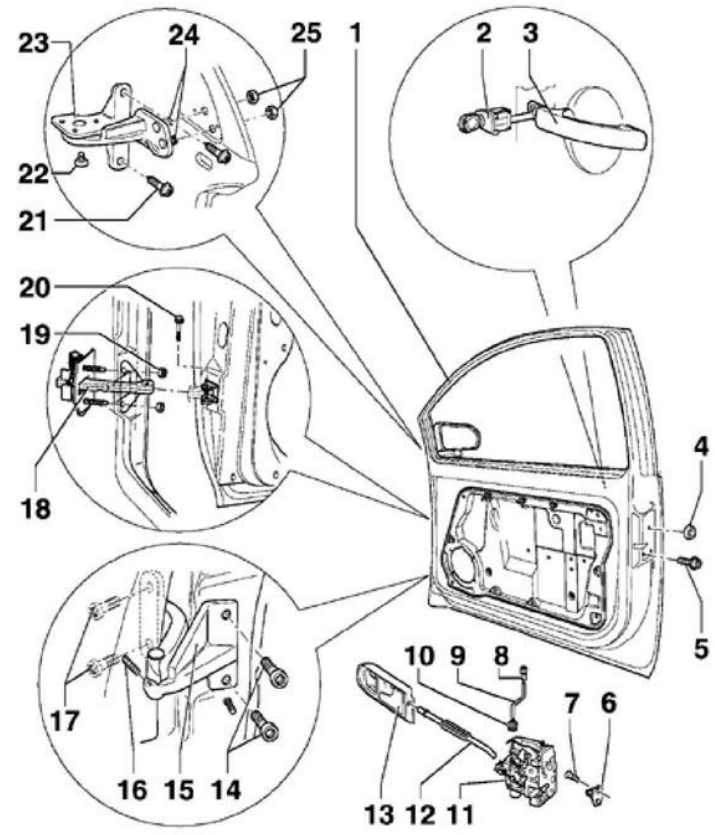
Part I

Oil filter bracket, disassembling. See **PART II**

NOTE: The following list refers to items in Fig. 102 .

1. **Oil pump**
   - 12 bar pressure relief
   - Make sure both centering dowels are installed
   - Replace if any running surfaces or gears are scored
2. **Chain sprocket**
3. **N.m (18 ft lb)**
4. **Chain**
5. **Sealing flange**
   - Removing and installing: See **SEALING FLANGE (FRONT), REMOVING AND INSTALLING** .
   - Insert with silicone sealant D 176 404 A2. See **SEALING FLANGE (FRONT), REMOVING AND INSTALLING** .
   - Crankshaft oil seal, replacing (pulley side). See **SEALING RING (CRANKSHAFT PULLEY SIDE), REPLACING** .
6. **15 N.m (11 ft lb)**
7. **Chain tensioner (with tensioning rail)**
   - 15 N.m (11 ft lb)
   - To install, first pretension spring
8. **Dipstick**
   - Oil level must NOT be above the MAX. mark!
   - Marks: See **Dipstick, markings**
9. **Guide**
   - Remove to draw out oil
10. **Guide tube**
11. **Centering dowels**
12. **O-ring**
    - Always replace
13. **Suction pipe**
    - Clean strainer if soiled
14. **Baffle plate**
15. **Oil pan**
    - Clean sealing surfaces before installing
    - Install with silicone sealant D 176 404 A2. See **OIL PAN, REMOVING AND INSTALLING**
16. **Seal**
    - Integral with oil drain plug
17. **Oil drain plug**
    - 30 N.m (22 ft lb)
    - Replace if leaking. See Parts Catalog for correct application. In some cases, seal and drain plug are

combined; do not interchange with separate seal and drain plug.



1 - Door
2 - Lock cylinder housing
3 - Door handle with base
4 - Cover cap
5 - Bolt/screw
6 - Lock plate
7 - Bolt/screw
8 - Locking button
9 - Locking button
10 - Boot
11 - Door lock
12 - Bowden cable
13 - Interior release handle
14 - Bolt/screw
15 - Door hinge
16 - Grub screw
17 - Bolt/screw
18 - Door arrester
19 - Nut
20 - Pin
21 - Bolt/screw
22 - Bolt/screw
23 - Door hinge
24 - Pin
25 - Nut

Fig. 102: Exploded View Of Lubrication System Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 103 .

1. **Sealing plug**
   - 25 N.m (18 ft lb)
2. **Gasket**
   - Always replace
3. **Oil cooler**
   - Make sure clearance between adjacent components
   - See note. See **LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING**
4. **Gasket**
   - Always replace
   - Install into oil cooler groove
5. **Seal**
   - If seal leaks, nip open and replace.
6. **Plug**
   - 10 N.m (7 ft lb)
7. **Sealing plug**
   - Do NOT open
8. **Spring**
   - For pressure relief valve, approx. 5 bar
9. **Piston**
   - For pressure relief valve, approx. 5 bar
10. **0.9 bar oil pressure switch -F1-**
    - 25 N.m (18 ft lb)
    - Gray
    - Checking: See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING**
11. **Gasket**
    - Always replace
12. **15 N.m (11 ft lb) plus additional1/4 turn (90°)**
    - Always replace
    - Place bolts first top left and right, then tighten all four bolts over cross
13. **Oil filter bracket**
14. **Seal**
    - Always replace
15. **Oil supply pipe**
    - To the turbocharger

16. **Banjo bolt**
    - 20 N.m (15 ft lb)
17. **Sealing cap**
    - 25 N.m (18 ft lb)
    - Loosen and tighten using 3417 oil filter wrench
18. **O-ring**
    - Always replace
19. **Oil filter element**

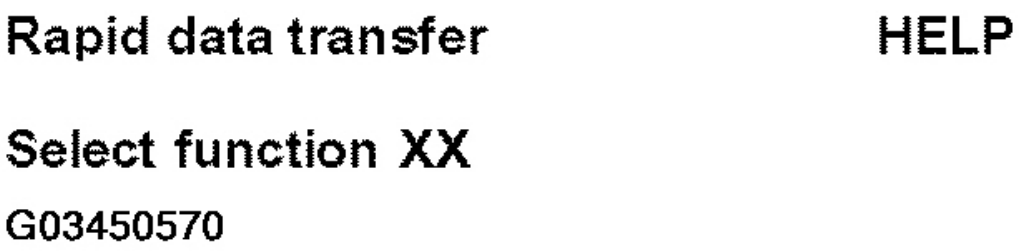


Fig. 103: Exploded View Of Oil Filter Bracket Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Dipstick, markings

NOTE: The following lists refers to items in Fig. 104 .

1. MAX. mark
2. MIN. mark

a. Area above cross-hatched zone up to the MAX. mark:

   Do not top-up with engine oil!

b. Oil level within cross-hatched zone:

   Can be topped-up with engine oil, as necessary

c. Area from MIN. mark up to cross-hatched zone:

   Fill with 0.5 ltr. (.47 quarts) of engine oil maximum!

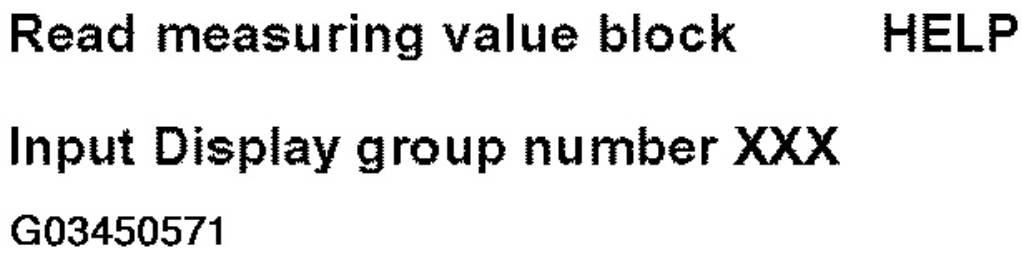


Fig. 104: Identifying Oil Level Mark On Dipstick
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Oil pan, removing and installing

Special tools and equipment

- Hand drill with plastic brush
- D 176 404 A2 Silicone sealant
- Scraper

Oil pan, removing

- Remove center, left and right insulation trays:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Drain engine oil.
- Unscrew oil pan.
- Loosen oil pan with light blows from a rubber hammer, if necessary.
- Remove sealant residue on cylinder block with a flat scraper.
- Remove sealant residue on the oil pan with a rotating brush, e.g. a hand drill with a plastic brush (wear protective glasses).
- Clean sealing surfaces, must be free of oil and grease.

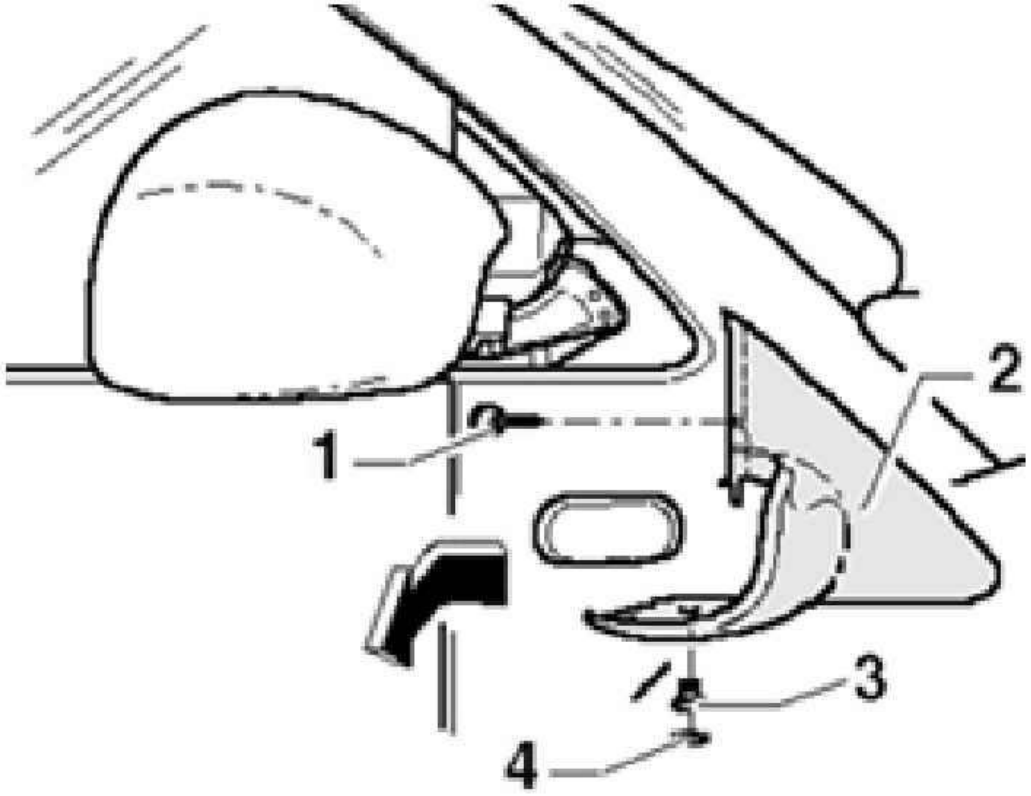


Fig. 105: Removing Sealant Residue On Oil Pan
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE:

- **Note the "use by date" on the sealant container.**
- **Oil pan must be installed within 5 minutes after applying the silicone sealing compound.**

- Cut-off tube nozzle at forward mark (approx. 3 mm diameter).
- Apply silicone sealing compound as shown to a clean oil pan sealing surface.
  - Bead must be: 2 to 3 mm thick.
  - Bead must run on the inside of bolt holes (arrows).

NOTE: The sealing bead must not be thicker, or excess compound will enter

the oil pan and may block the suction pipe strainer.

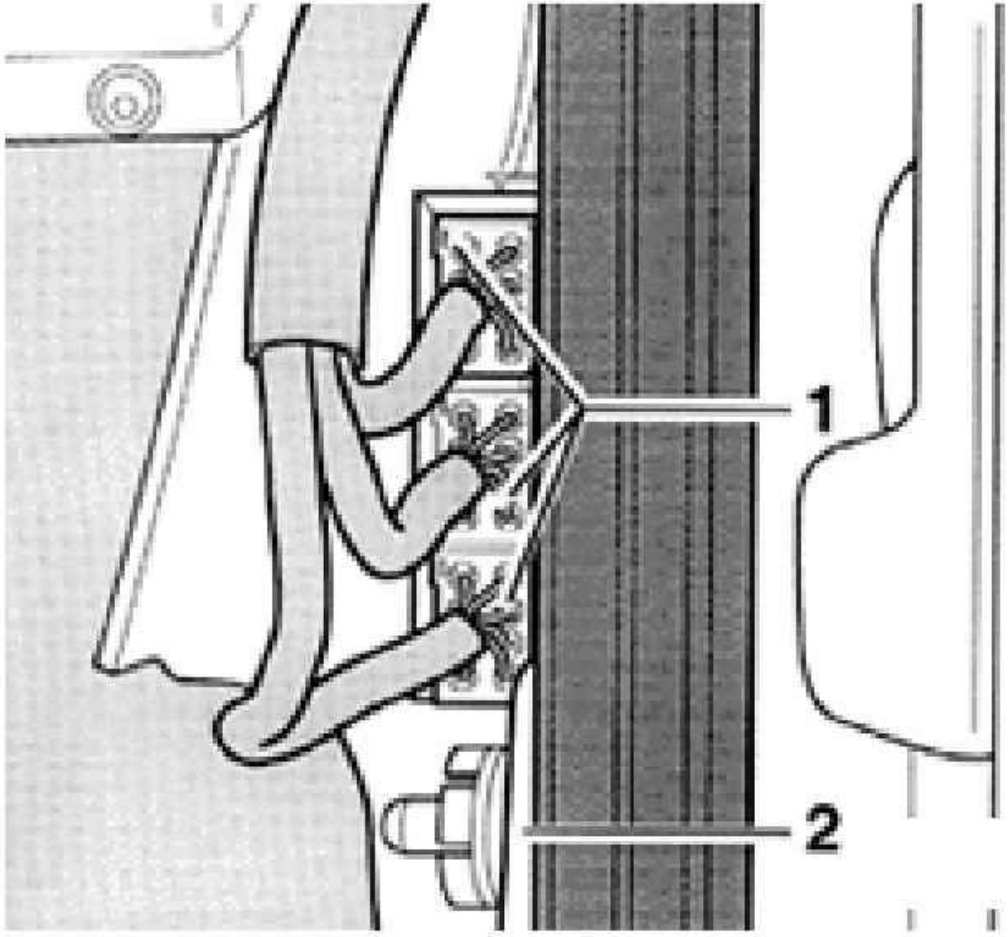


Fig. 106: Applying Silicone Sealing Bead On Oil Pan (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Apply silicone sealing bead as shown to the clean sealing surface of the oil pan. (illustration shows position of sealant bead on cylinder block).
- Immediately install oil pan and lightly tighten all bolts.

NOTE: The oil pan must be aligned flush with the cylinder block.

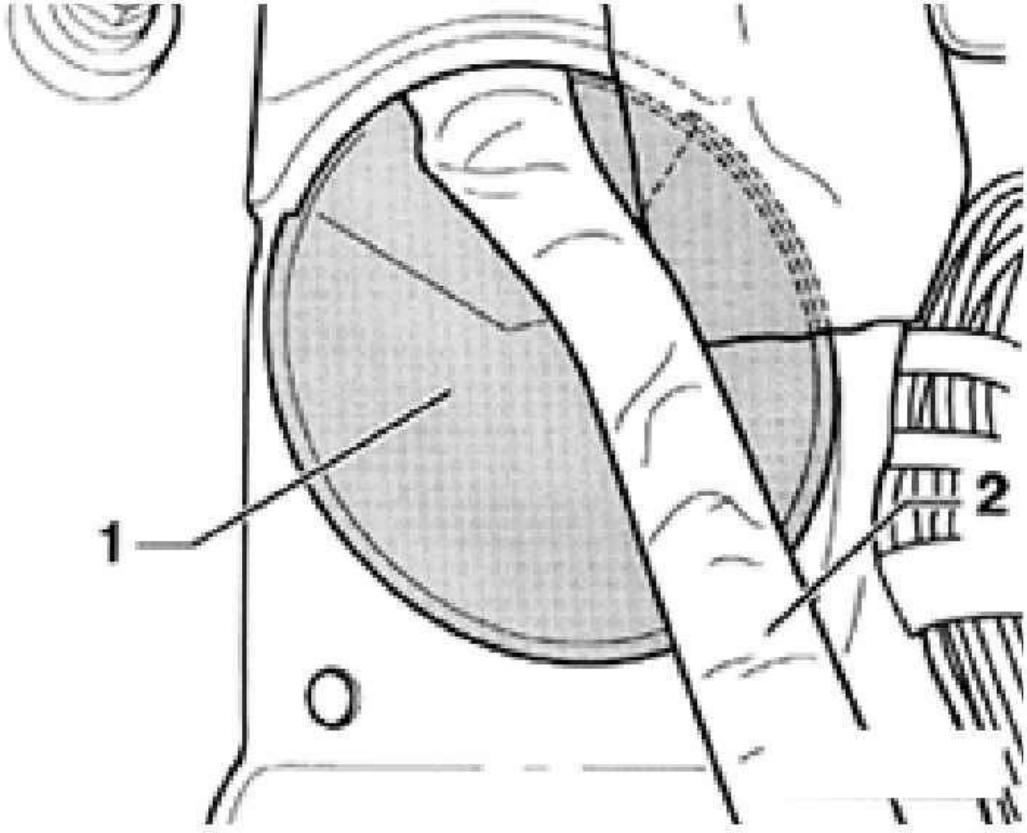


Fig. 107: Applying Silicone Sealing Bead On Oil Pan (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten oil pan bolts to 15 N.m (11 ft lb).
- Tighten oil pan/transmission bolts to 45 N.m (33 ft lb).

NOTE:

- **After installing the oil pan, allow the sealant to dry for approx. 30 minutes before adding engine oil.**
- **Assembly is the reverse of the disassembly sequence.**

Oil pressure and oil pressure switch, checking

Special tools and equipment

- VAG 1342 Oil pressure gauge

- VAG 1527 B Voltage tester
- VW 1594 adapter kit

NOTE: Functional check and servicing the optical and acoustic oil pressure warning:
See appropriate WIRING DIAGRAM article

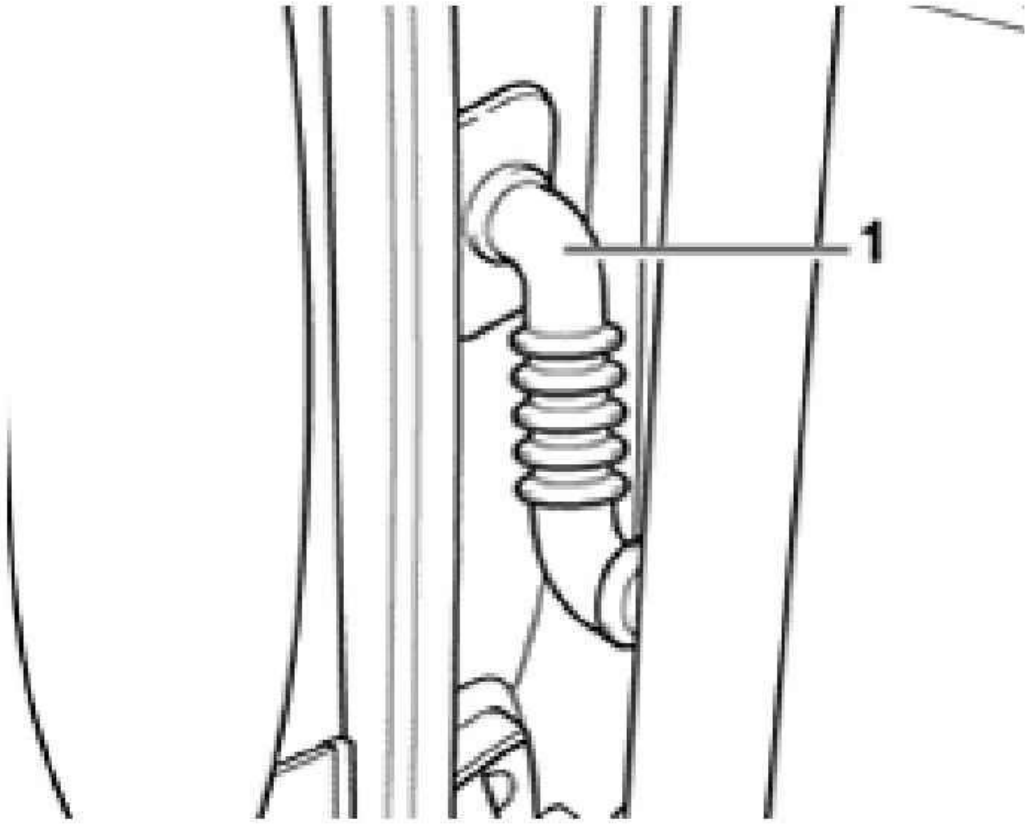


Fig. 108: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Test sequence

- Remove oil pressure switch -F1- and screw into tester.

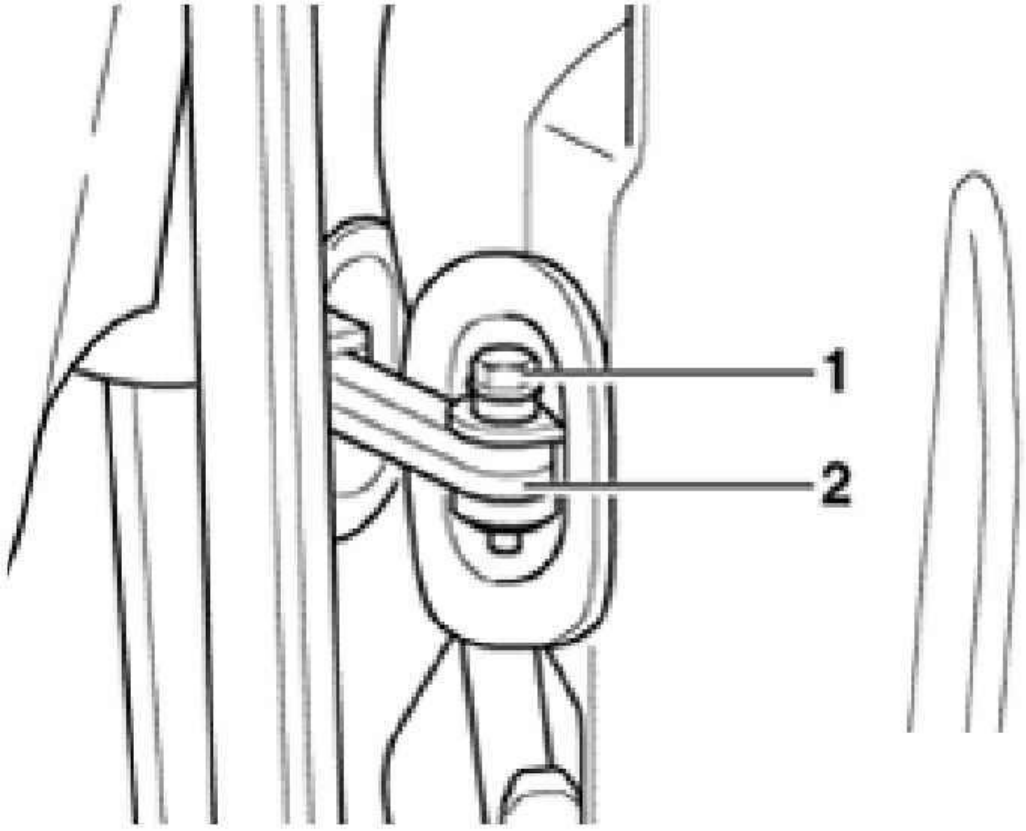


Fig. 109: Checking Oil Pressure Switch
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Screw tester into filter bracket in place of pressure switch.
- Connect brown tester wire to Ground.
- Connect VAG 1527B Voltage tester between battery Plus and oil pressure switch using jumper wires from VW 1594 adapter kit.

If LED lights up:

- Replace oil pressure switch -F1-.

If LED does not light up:

- Start engine and slowly increase engine speed.

At 0.75 to 1.05 bar, LED must light up. If not replace oil pressure switch -F1-.

- Increase engine speed further.

  At 2000 RPM and an oil temperature of 80°C, oil pressure must be 2.0 bar minimum.

NOTE: **At higher engine speeds, oil pressure must not exceed 7.0 bar. If necessary replace oil pump cover complete with pressure relief valve.**